

# Aviation Week

and *Space Technology*

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A McGraw-Hill Publication

September 4, 1961

**SBAC Views  
Future For  
Farnborough**

Hawker Siddeley P.1127 VTOL Fighter



Special Reports

## Rolls-Royce Turbine Engine Experience

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## How Alloy Steels Respond to Induction Hardening

In the induction-hardening process, steel is first heated above the transformation range by means of electrical induction, then quenched as required. Special equipment is needed, and heat is developed as follows:

High-frequency alternating current passes through a coil or inductor, with the result that a magnetic field is created in the coil. When the piece to be treated is placed in this field, it is heated rapidly by induced energy. With the various types of induction-heating equipment, the process is capable of surface- or case-hardening to various controlled depths; however, through-hardening can be obtained with certain alloy steels. Ferrous metals that respond well to induction hardening include numerous grades of both alloy and carbon steels, as well as hardenable stainless steel and plain or alloyed cast iron.

As a rule, when alloy steels which contain non-carbide-forming elements, such as nickel, are heated by induction, the usual hardening temperatures can be used. But with alloy steels that do contain carbide-forming elements such as chromium, molybdenum, and vanadium, the hardening temperature must be increased if the normal effect of the alloying elements is desired.

Hardness obtained by the induction process is a function of the carbon content and prior structure, just as it is when conventional

heating methods are used. Nevertheless, higher surface-hardness values for a given carbon content have often been noted in parts subjected to surface induction-hardening. The extra hardness may be as much as five Rockwell C points for steels of 0.30 pct carbon.

As pointed out previously, the induction method requires special equipment. However, it possesses several marked advantages, including speed of heating and cleanliness of operation. Pieces heated by induction are usually subject to a minimum of scaling and distortion. Moreover, induction-hardening equipment is very compact and therefore conserves floor space.

If you would care to know more about the induction hardening of alloy steels, please communicate with our technical staff. Bethlehem metallurgists have made a thorough study of the subject, including the many details of quenching and tempering. Call them if they can help you in any way. And remember too that Bethlehem makes the full range of AISI standard grades, as well as special-analysis steels and all carbon grades.

*This series of alloy steel advertisements is now available as a compact booklet, "Quick Facts about Alloy Steels." If you would like a free copy, please address your request to Publications Department, Bethlehem Steel Company, Bethlehem, Pa.*

### KNOW YOUR ALLOY STEELS . . .

*This is one of a series of advertisement booklets which have been about alloy steels. Though much of the information is elementary, no effort is made to be of interest to many in the field, including many of those who may find it useful to review fundamental facts from time to time.*



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# Flight Propulsion NEWS

A report on progress in research and products from the Flight Propulsion Division of the General Electric Company



## G.E.-powered Turbochargers Ordered for RCAF Service

**BUCKINGHAM** Press—Two Boeing-Vertol 167 helicopters powered by twin General Electric T56-A turboshafts have been ordered by the Royal Canadian Air Force for use in highly specialized search and rescue vehicles.

Designed C-119s, the aircraft will have exceptional load-carrying capacities, permitting them to transport external payloads of up to 30,000 pounds using a special air-to-air cargo hook.

With the aid of large capacity fuel tanks, the turbochargers will be able to carry a 3,000-pound payload more than 650 miles.

The Boeing Vertol 801 is one of several U.S.-built military and commercial turbochargers powered by the 1750-shp T56 turboshaft engine. As a commercial helicopter it will enter service with New York Airways later this year, when it will carry 25 passengers at 155 mph, and is expected to help reduce seat-mile costs below those possible with present jet-powered helicopters.

Other military turbochargers powered by the General Electric T56 engine are the Korea HU-16, to be used for Navy utility, search, and rescue missions; the Boeing-Vertol H-19, recently selected as assault transport by the U.S. Marine Corps; and the Sikorsky HO-4, a USN anti-submarine helicopter that recently established a new world helicopter speed record.

Commercial versions of the HO-4, the Sikorsky S-61, enters commercial service with Los Angeles Airways and Chicago Helicopter Airways later in 1965.

The smaller Sikorsky S-61, powered by a single boosted G.E. T56 engine, is currently hauling passenger service in Los Angeles, San Francisco, and Tokyo. The S-61 was the first U.S. helicopter to be certified for commercial operation. Its G.E. engine was the first U.S. helicopter gas turbine powerplant certified by the FAA for commercial operations.

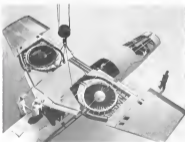


Boeing-Vertol 167, selected by Canada



**FIRST RUN-UP OF G-E T64 ENGINES** in the defuncted D-6C-4 Caribou occurred at defuncted Downsview, Ontario, plant recently. The two tests of the environment STOL aircraft will lead to flight testing of the General Electric turbojet engines later this summer. The program is being conducted by G.E.'s Small Aircraft Engine Department and defuncted Aircraft of Canada under U.S. Navy sponsorship and with cooperation of the Canadian Government.

G.E.'s T64 turbojet engine, which develops 2530 equivalent shaft horsepower and has a corresponding specific fuel consumption of 0.46, is currently under consideration for several advanced, medium-range transports. T64 turbojet configurations have been proposed for a variety of VTOL ships.



**FAN-IN-WING MODEL READY FOR TESTS**—Next test phase for the General Electric fan-in-wing will be in a fan-in-wing configuration. Testing will be conducted in the NASA Ames, California, 40 x 80 wind tunnel. The two-fan, two-jet engine powered wind-tunnel model will provide aerodynamic and aerodynamic design data for subsequent flight research aircraft.

Tests will begin in September, 1965, in this continuing V/STOL propulsion system research effort under Army (TRACOM) contract.

## J79 Engine: Power for Eighteen U.S.-held Flight Records

**CINCINNATI**, G—G.E. aircraft powered by General Electric J79 engines have captured nearly one-half of world aviation's official jet speed, altitude, and time-to-climb records during the past two-and-a-half years.

Of 42 internationally recognized records in three time categories, 20 are currently held by G.E. military aircraft. All but two of the 15 speed records were flown by J79-powered jets—Covair's B-58 Hustler; the Lockheed F-104 Starfighter; the McDonnell F4H Phantom II; and North American's A-1J Vigilante.

Most of these record-breaking performances are credited to the Lockheed Starfighter, which holds the official altitude record of 102,198.5 feet and 11 night time-to-climb records from 3500 to 30,000 meters.



McDonnell F4H Phantom II holds 11 night time-to-climb records from 3500 to 30,000 meters.

## Covair 380 powered to three records by CJ-805 engines

Powered by G.E.'s CJ-805-3 turbojets—commercial versions of the J79—the Covair 380 jetliner has established three major domestic speed records since entering service in May, 1964. On its first delivery flight for Delta Air Lines the Covair jet reached 3390 miles from San Diego to Miami in three hours and 32 minutes.

A few months later 380's destined for Northwest Airlines cut San Diego to Boston flight time to four hours and 10 minutes.

Most recently, a TWA 380 set a new commercial speed record when it linked San Francisco and Chicago in five hours and 57 minutes—35 minutes under the scheduled flying time.



Covair 380 three records the first year

Covair's B-58 Hustler, demonstrating its prowess as the nation's first supersonic bomber, has set several world speed records since the start of 1961. In January, the Mach 2 bomber earned a 3,000-kilometer payload over a 3,000-kilometer closed-course, averaging 1811.7 miles per hour. The flight set new records for three different payload classes. A few days later another Hustler clinched the 1,000-kilometer-course record for the same three payload classes with an average speed of 1344.70 mph.

The Hustler's record, the 1964 Thompson Trophy for the fast, later, in May another Hustler claimed permanent possession of the Brant Trophy—1000 statute miles at 2300 mph for more than 30 minutes over a closed course.



North American A-1J Vigilante set a USNR altitude record by nearly 35,000 feet.



Lockheed's F-104 holds nine world flight records that no other American aircraft

Another U.S. Mach 3 aircraft, North American's A-7 Sparrowhawk, took its place in international aviation records during 1964 when it smashed the Russian-held 3200-kilometer payload altitude record by nearly 25,000 feet. The J79-powered Vigilante's record still holds at 9,143.6 feet.

Fourth member of the J79-powered record-breaking team, the McDonnell F4H Phantom II, broke two 30-minute-held records in the fall of 1964. The Mach 2 Navy fighter streaked over a 500-kilometer closed-course at 1236.18 mph, and a few weeks later logged 1390.21 mph over a 300-km closed-course.

Most recent proof of the Phantom II's prowess came in May of this year when the J79-powered fighter captured the Brant Trophy by clocking 25 minutes from the previous jet-American flight record.

Of these four J79-powered jets, two—the F-104 and the B-58—are currently in operational duty. The F4H Phantom II and A-1J Vigilante are expected to enter fleet operations with the U.S. Navy in the near future.

For a free brochure tracing full-color illustrations of these record-setting aircraft—F4H, A-1J, F-104, B-58, and B-58—fill in and mail the coupon below.



Record-setting Covair Hustler is the world's first supersonic Mach 2 bomber.

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[Wyle tells an alloy steel wire used in missile applications revealed also

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Among test samples prepared from air-melted wire, 18 out of 20 failed at

the weld.]

Among similar samples prepared from the vacuum melted wire of the

same grade, only two out of 20 have failed at the weld.]

[Different types of Cannon-Muskegon vacuum melted welding wire are

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The USN Aero 43L reel-launcher proves growth potential of standard basic gear...



## THE AERO 43L LOOKED GOOD IN OPERATION... PROVED EVEN BETTER IN TOUGH LAB TESTS!

The Aero 43L combination reel-launcher was selected by the U.S. Navy as the basic component of an improved aerial target system with potential use on the A-1, the F-4, and the F-3H aircraft. The Aero 43L was the result of continual improvement of standard equipment operationally proven over a period of ten years. If it performed—it was thought by BuWing that it might also be a suitable answer to the Navy's F-4H Phantom aerial target needs—a safe place to put the taxpayer's money in the present state of the art.

So the CNO went for action, and the Aero 43L took to the air. It looked good. It behaved well! No hose defects could be discerned in preliminary operations.

But true up to 184 years tradition of leaving nothing to chance, the Navy's equipment watchdogs prudently suggested that what seemed to behave well under favorable field conditions may not always stand up well under the extreme rigors of continued field usage. So the Aero 43L was on its way to a highly respected, independent testing laboratory.

INSTRUCTIONS: Subject the Aero 43L to the toughest structural load tests ever devised for such equipment.

ANALYSIS: Prove it beyond a doubt—in such a test result: The Aero 43L is structurally "A-OK" in all respects!

The Conclusion: Thanks to BuWing's policy of evaluation of improvement in qualified basic gear and to diligent persistence in proving the superiority of such equipment—U.S. taxpayers can rest assured that the operational squadrons of their Navy and Marine Corps will continue to be amongst the best trained, most consistently all sources of the free world.

The Aero 43L is a product of Del Mar Engineering Laboratories—another development of new aerospace working atmosphere with the same success. Write Dept. AE-283-L.



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portable pressure standard for  
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Five-chamber converter for calibration and test  
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—104 21 in. x 21 in. x 21 in. (104 standard) 21 in.  
diameter pneumatic signal (accuracy 0.005 in.  
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This compact, lightweight package is a self-contained  
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The most recent example of General  
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which has a nominal noise  
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#### LOW-NOISE TWT'S

Frequency (MAC)	Maximum Noise Figure (db)	Signal Gain (dB)
3-6	4.5	20
4-8	10	25
7-15	12	30
2.5-8.5	7	35
8-12	10	35
14-18	14	35

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Frequency (MAC)	P <sub>0</sub> (W, CW)
3-10	1.5 W
10-20	1.5 W
20-500	2.0 W
50-500	2.5 W

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Tube Department, General Electric Company,  
Schenectady, N. Y. Ask for Bulletin PT-10.

# 5 New propeller developments to answer key VTOL problems

1. The variable-camber propeller, now under development for the Navy, combines capabilities of both a high- and low-lift airfoil to meet high takeoff thrust requirements without sacrificing cruise efficiency. By differentially changing the angle of curved blades mounted on a common hub, the variable camber propeller provides an ideal solution to a classic problem of VTOL flight: the need for high takeoff lift and efficient cruise capability of the propulsion system.

Patent studies show the variable camber propeller could make possible a number of major performance increases for varied types of future aircraft.



**FOR TAKE OFF AND LANDING:** blade angles are adjusted differentially so that each pair of blades constitutes a high-camber airfoil for maximum thrust.

**FOR CRUISE:** the paired blades automatically position to act as individual low-camber airfoils for maximum efficiency.

2. An advanced reductant control system, with self-contained, separate hydraulic system, components, and stand-by master controls, is also under development. This system will provide a whole new level of reliability and sensitivity through critical VTOL operations—lift-off, landing, and transition to forward flight.



**CONTROL LEVEL REPLACEMENT: MINORITY COMPARISON OF VTOL and conventional propeller controls.**

3. Shrouded propeller versions of the variable camber and conventional blade propellers are presently in advanced stages of study at Hamilton Standard. For VTOL, and other aircraft applications, shrouded propellers with 30% smaller blade diameters will deliver performance equivalent to five propellers with conventional size blades. Resulting size and weight savings meet VTOL requirements for compact system configurations.



**SHROUDED PROPPELLER,** as part of innovative Hamilton Standard program, undergoes high-speed wind tunnel tests.

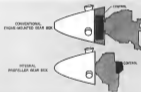


**FULL-SCALE** lightweight blades endure extensive fatigue tests at Hamilton Standard.

4. New Lightweight Blades, under development for the variable camber and conventional propellers, consist of a primary load-carrying steel spar and a fiberglass shell. The proven tubular steel spar design approach permits a high strength-to-weight ratio; while the fiberglass cover provides a

maximum weight airfoil, easily tailored to any specified blade planform.

In VTOL applications, for example, this blade design will reduce propeller weight by as much as 25%, and will permit a significant decrease in overall aircraft weight with correspondingly improved performance.



**INTERNAL GEAR BOX** propeller installation eliminates duplicate housing and other components, achieves a 15-20% reduction in the combined propeller and gear box weight. Permits considerably more compact configurations for VTOL aircraft.

5. A weight-saving integral gear box, which combines engine reduction gearing and main propeller controls within the propeller assembly, is also being developed under Navy con-

tract. This integral gearbox will simplify gearing in any propeller application and provide important weight savings in VTOL and other advanced aircraft designs.

Answering key problems of VTOL and other advanced aircraft is the object of a comprehensive development program at Hamilton Standard

today. This work is a natural outgrowth of more than forty years of designing and producing propellers for the aircraft industry.

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**HAMILTON STANDARD DIVISION**  
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ride for a B-52... VICKERS hydrostatic drives assist positive traction on icy airstrips

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September 4, 1987

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## and Space Technology

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USAF Seeks \$715 Million for Pluto Program 29

Some congressional skeptics over effects of defense, extra funds would accelerate nuclear ramp-up for Star

Passenger Fares Cuts Expected to Spread 38

Industry hopes to attract downward swing in traffic but spurs over what types of special routes to use

Farnborough to Remain All-British Show 78

Britain's aviation industry will keep its Farnborough show a strictly British activity despite British international involvement

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This gigantic GCR-proposed solid propellant booster is made up of easy-to-haul segments that simply would be bolted together at launch site. It could put a 250,000-pound space station in orbit—or send a 100,000-pound manned spacecraft to the moon. It can be developed, built, tested, assembled, maintained, and operated for a small fraction of the cost of a comparable liquid system—yet it is much more reliable. It can be operational by 1966—if we start now. Smaller solid boosters—able to orbit 50,000 pounds—can be available by 1964. **GRAND CENTRAL ROCKET COMPANY**

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## EDITORIAL

### The Nuclear Shoe Drops

Soviet Union's announcement that it is officially renouncing nuclear weapons testing, which, probably will include the newly designed 100-megaton warhead should come as no surprise to readers of *Armstrong West*. More than a month ago we warned that the Soviets would follow their Tashkent air show surprises with more shocks to the West, and this time in the area of nuclear weapons. In *Armstrong West* of July 26 (p. 21), in part of an editorial titled "Another Surprise Coming?" we wrote as follows:

"However much of a shock it is to the American people to discover that the Red Air Force, which was supposed to be fading into obsolescence, had suddenly blossomed out with a full array of new generation aircraft across the whole technical spectrum from supersonic bombers and long-range interceptors to assault transports and helicopters, we wonder if an even greater shock may not be in the offing. We wonder if the self-satisfied ban on nuclear testing that the United States has been operating under for the last three years may not be leading toward the disruption of our once commanding lead in nuclear weapons development. Will we wake up another Monday morning soon and find that the Soviets have been secretly testing new generations of nuclear weapons when they continued in public with their operational capability?"

The Soviets have now done just that. It was no coincidence that they first prepared their ban on further nuclear testing almost immediately after they conducted the largest series of nuclear tests in their history. These tests presently provided sufficient proof testing of new nuclear weapon designs to keep Soviet production facilities humming while their scientists stilled down to designing the next generations of nuclear weapons that would not require proof testing until the 1961-62 period. Then the Soviets got a true test for their supposedly humanitarian gesture during a period when they resumed no large-scale atmospheric testing anyway. The U.S. accepted the Soviet pledge, literally caused all kinds of nuclear weapons testing and imposed an artificial three-year delay that ran counter to our own development requirements, both for larger yield ICBM warheads and smaller battlefield weapons in the lower kiloton range.

#### Soviet 'Newspeak'

Now that the test ban no longer puts their practical purposes, the Soviets cynically drop their humanitarian pose and tell the world they are going to test the biggest new destruction weapons of all time—weapons that probably also will produce a new high in atmospheric contamination and widespread fallout. Their public act (one for this world about face is couched in the hot phrases of "Newspeak," the Orwellian language of the novel "1984" in which war is peace and peace is war, black is white and white is black. Unleashing the new force of a 100-megaton weapon, according to the Soviets, is done only in the interests of world peace and was forced upon them by the "capitalistic warmongers" acting as double-crossers against the latest Soviet weapons on Berlin.

It is a well known fact that Soviet submarines and electronically guided missiles have been using the interactive sea around the Atlantic and Pacific, mobile test stages and showrooms along our coasts to enlarge their knowledge of our defenses and the management for their offensive weapons. The Soviets have complained bitterly about the identification of these "peaceful fishermen in international waters" by U.S. Navy patrol planes. Now that U.S. nuclear powered submarines armed with Polaris missiles are beginning to appear on stations around the Soviet perimeter, the Russian propaganda machine has begun to howl about "springing forward submarines" and to threaten them with destruction. All of this bold Soviet cynicism follows a long-established pattern but unfortunately there are some Americans who still can be deluded by these Soviet assertions.

The military requirements of the U.S. and the Soviet Union are vastly different, and no doubt there will be a continued argument by the learned military experts in the Congress, the press and the pulpit over whether possession of a 100-megaton bomb and the ballistic missile delivery system to put it on target offers the Soviet Union any significant military advantage. Unfortunately, most of this argument will be focused on our own military requirements and foreign policy and not on that of the Soviet Union.

#### Satellite Terror

The 100-megaton warhead and its delivery system offer a new new tool for the Soviet game of bluster, threats and international blackmail. More than a year ago we also warned that the Soviets would proceed from their usual nothing to space satellite nothing as soon as they produced the required hardware. They now have all of the hardware elements to produce satellite blackmail as the very next feature. The 100-megaton weapon adds another element of terror to the nuclear arsenal, the nuclear they have already demonstrated can hurl this new weapon into orbit (perhaps with a man aboard to control it) and precise re-entry techniques that could bring it back onto a terrorist target, with an currently known means of defense against it, have been demonstrated.

Some will argue that this is an inefficient method of delivering this weapon to a target, and indeed it may be. But the real value of a weapon of terror such as the Soviets now are constructing is not in its actual use but in its psychological effect on the people over whom it is dangled like a Damocles sword. We wonder what the effect would be on the populace below of a series of highly publicized Vandals orbiting above every few hours and brandishing messages to earth that this is "your friendly Soviet astronaut enroute so-and-so with a 100-megaton warhead aboard ready to go any time any body opposes the 'peaceful policies' of the Soviet Union."

What will the countries wobble up to the character of the struggle for survival in which we are already heavily engaged and the safety of the beast that is leaping for our perils?

—Robert Flota





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## Washington Roundup

### Saturn Competition

Industry is pressing hard to get a systems management contract for the Saturn space booster, once assembly and test of the S-1 fast stage moves out of what is called "the NASA annual" at Huntsville, Ala., and into a contractor operation. NASA expects to select an A&T contractor soon—possibly by late this week.

Although NASA wants industry to win a "Work Wipe II" test plant near Michael, La., for the assembly job, most companies still prefer other sites. Estimates put the \$13 contract potential at more than \$1 billion, since the success of that competition is expected to have an edge in building for the S-1B. It will see two F1 engines suffer from the right 11-11 that will prove the cul-de-sac first step.

An indication of the intense competition within industry for the job, Boeing is considering leasing 100 acres in Oregon for an assembly and test site, and Ford's Aerospace Division has sent a team to survey the Midland plant. Boeing also has decided to forgo bidding for the Apollo spacecraft in order to concentrate on S-1, and has shifted Dr. George Swain, who was managing the company's Dyna-Star work, to director of the competition for S-1.

### Berlin Airlift

If another Berlin airlift should be required (see p. 39), the Douglas C-124 Globemaster would become the southern aircraft. In the 1948-49 airlift to Berlin, the heavy work was done by Air Force and Navy with the Douglas C-124 (R5D). Now, however, the greatly expanded operation often carries cargo, including Douglas C-119s, a limited number of C-119s, and the venerable C-47, Lockheed C-119s and C-130s, and the C-130. Many of the C-119s and R5Ds used in 1948-49 still avoid areas of coal dust during contact.

Opposition to Project West Wind exposed at the recent convention of the International Astronautical Union will not keep Defense Department from proceeding with plans to place 76 lb. of radioactive metal debris in orbit to serve as an artificial satellite at various times in the future. The White House already has issued statements that it will consider their worth before deciding whether to send an operational belt of needles, but the IAU passed a resolution opposing even the first experiment "until the question of the permanence (of the orbiting debris) is clearly settled." Air Force is trying to develop materials that will sublimate in the space environment to a belt could be given a determinable lifetime.

### Space Council Hiring

National Aeronautics and Space Council has begun the building of its technical staff by hiring Dr. Charles S. Sheldon II, who has been on the technical staff of the House Science and Astronautics Committee since 1955.

Although he is an economist and transportation expert, his title on the House committee has given him a broad view of the governmental and technical aspects of space. Dr. Edward C. Webb, the council's executive secretary, told AVIATION WEEK he does not intend to recruit specialists and assign them to specific technical areas. Instead, he will use the many talents employed by President Kennedy, whom Webb believes will work in a variety of fields.

The council got the full \$320,000 appropriation it asked for, and Webb said he expects to have a staff, including clerical help, of 15 or 20 people by the end of this fiscal year. He also hired Henry G. Elder, president of the National Rocket Corp., to El Segundo, Calif. Sheldon began work this week, Elder later on.

House Science and Astronautics Committee, after looking into everything from the atomic option to supersonic transports to orbital roadshows, has called it quits for this year. No more hearings are scheduled by the full committee.

### New Strategy

A second attempt is being made to get \$499,000 in Defense Department funds to allow National Aeronautics and Space to sponsor the 1962 international conference on the Federation Aeronautique Internationale and five world aviation championships. A bill introduced in Congress earlier this year by Rep. Chas. Tamm has not moved out of the House Armed Services Committee because Defense opposed it.

Now Sen. Warren Magnuson has introduced a similar bill. It has been referred to the Senate Foreign Relations Committee—opponents say the former deal national pride and worldwide prestige to the United States, while the latter deal with space. There, since 1955, has held 100 of the 403 world aviation records compared with 95 held by the U. S.

Soviet Berlin is training 35 Chenevix in aircraft pilots and engineers and expects to train a total of 149. They will replace Americans on the state-owned airlines.

Air Force System Command and Air Force Logistics Command, subjected to the Washington pressure for reforming all organizational means to tactical air support, concern "NoCo" and "LoCo."

—Washington Staff

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## Four Ranger Vehicles to Be Added To Unmanned Lunar Probe Effort

**Tombura, Calif.**—Four Ranger spacecraft will be added to the National Aeronautics and Space Administration's unmanned lunar exploration program in an effort to obtain high-resolution television pictures of the moon's surface in support of the Apollo manned lunar program. Dr. Robert C. Sorenson, Jr., associate administrator of NASA, said here last week.

Other integrated changes in the NASA-JPL Propulsion Laboratory are planned later and elsewhere reflect

tion programs will not decrease, however. These include the expected additional launch vehicles to the Soyuz and other lander, planetary lunar vehicle program, scheduled here last month by Abraham Ilavsky director of program planning and collection for NASA.

In addition there are indications that NASA and JPL are considering cancellation of the Mariner-Venus deep space probe. The feeling is that Ranger spacecraft (beyond the nine now scheduled) could be modified to accomplish

planetary exploration missions planned for Mariner sooner than the latter could. The four additional Ranges are intended to be launched by the Saturn I through RA-5, a series which might be expanded again if Mariner is dropped. Originally, JPL intended to fly two non-impacting Ranges, a second of which Dr. W. H. Pelton, JPL director, said might take place in about a month. The program was to have been completed with the last landing of this package (RA-5 through RA-6) on the moon's surface.

Expanded schedules for the remaining four shots of the original program cannot be ascertained.

Rangers RA-3, 4 and 5 will take TV pictures of the moon's surface from lunar impact. An instrumented capsule containing a seismometer, temperature measuring device, and a radio will be rough landed on the moon's surface in each shot.

Ranger RA-6 through RA-9 will not carry the instruments to be used in the early lunar landings of RA-1, 4 and 5. They high-resolution television TV cameras and necessary instruments for returning pictures to earth, will replace the instrumented capsule used in RA-3 through RA-5. These spacecraft are expected to impact at 15,000 mph, rather than the 200 mph impact velocity of the first several Ranger payloads.

The Astro Electronics Division of Radio Corp. of America in Princeton, N. J. will develop the television system for Rangers RA-6, 7, 8 and 9.

JPL officials indicated many of the intended missions of Ranger-1 (AW Aug. 28, p. 29) were achieved despite the failure of the spacecraft to achieve the desired trajectory. These missions included the test of elements in the spacecraft, gaining experience with the Lockheed Agena B and test of deep space communications facilities.

All but one of the eight scientific instruments on Ranger provided data, although not necessarily the data originally desired. The video reconnaissance television analyzer and a Lunar-sky telescope provided little scientific data. The seismometer on the spacecraft was useless because it was activated by the high-impact shock encountered in the low earth orbit and because of its extreme temperature sensitivity.

A triple coincidence neutron radiation counter, a cosmic ray neutron detector, medium range particle detector and a neutron monitor counter were all reported to yield useful scientific information.

A Van Allen experiment obtained good but inefficient data for desired statistical analysis.

Ranger-1 returned earth's atmosphere Aug. 29 and burned up after less than a week in orbit.



### Planned Atlantic Missile Range Expansion

Area in blue at top shows the 16,000-acre site to be opened by the National Aeronautics and Space Administration for expanding the Atlantic Missile Range to accommodate Navy and advanced State launch vehicles (AW Aug. 28, p. 28). President has asked Congress for 140 million to buy the land. Cape Canaveral launch area at lower right, consists of 25,000 acres and will handle launches up to 1.3 million lb. fired. New facility in the suburbs of 150 million lb. thrust category.



### Four-Segment, 500,000-lb.-Thrust Solid Motor Tested

AvcoCorp.'s solid motor, composed of four segments, 300 in. in diameter and totaling about 15 ft. in length and containing approximately 180 tons of polychloro propellant, is shown at left of section Sacramento, Calif., being. Full thrust of more than 500,000 lb. was generated for 67 sec of the 67 sec test. This was the fourth in a series of test firings in the large solid motor program and was preceded by the firing of a three-segment booster in June (AW June 12, p. 33).

## Soviet Space Gains Threaten U.S. Security

Los Angeles—Soviet thrusts will now open to jeopardize U.S. security if the moon allows Russian satellites and earth-orbiting spacecraft to support them. Dr. Robert C. Sorenson, Jr., associate administrator of the National Aeronautics and Space Administration, said last week.

"U.S. mastery of space is essential to our security against foreign threats with a technology which is the last space will develop on the space frontier," he said.

Sorenson told the Ballistic Missile and Aerospace Technology Symposium, held here by the Air Force and Aerospace Corp., there is a need to maintain superiority over the Russians in space, since the competition involves potential direct military conflicts and a deadly competition for the support of the mechanized people of the world.

Dynamic space achievements in art, law, science "today's marked of tomorrow's scientific and technical superiority."

Sorenson said the growth of space research is comparable with that of nuclear physics after World War II. He said that space programs are cutting across the boundaries of established sciences, drawing together scientists of differing backgrounds and bringing new ideas and concepts into traditional disciplines.

Explaining NASA's desire to support manned space flight, Sorenson said "integration of a human pilot into an onboard spacecraft system greatly improves reliability. The man can not

only make mid-flight tests but also in-flight repairs. We have existing examples of this in missions of NASA's X-15 rocket airplane which has been brought to the fringes of space and has achieved a speed of 5,000 mph.

"To at least eight of 20 X-15 flights to date, flight would have ended with a pilot in the cockpit to correct malfunctions of equipment, instruments

or personnel." In at least as many other cases, if X-15 missions had been unmanned, we would have obtained no information because other instruments or telemetry failed. The X-15 pilot, however, was able to land with valuable flight information recorded by his own senses."

In the future, Sorenson said, the three-day mission, Air Force Secretary Eugene M. Zariski said, would be the complete replacement of the service or of its industrial outposts.

He said "in the connection I considered to your attention the recent report issued by the House Committee on Government Operations, based upon an extensive study by six military agencies, soberly pointing out the direction of Chairman Carl Albert (D-Calif.) It is an outstanding example of constructive legislation."

Finally, the speaker gave an interesting concept, a vote of confidence, but coupled with it words of warning, words not noted to heed. When the next few months, he said, represent the ground state specifically ordered to fit the structure of mankind's progress—man—an area which by its own nature is entirely the focus of attention."

Later, Zariski acknowledged that the committee report had been which is interpreted as critical of the Air Force practice of management by nonmilitary engineers but said the Air Force could select a far-sighted approach.

### Military Space Effort

Washington—Chairman John Stennis (D-Miss.) of the Senate Permanent Subcommittee on Investigations is pushing for a large role for the military in the U.S. space program.

In a Senate speech, Sen. Stennis said "space technology will eventually become a decisive factor in determining our national military strength. It is time to move ahead with space control of the world." He said the operations of military and civilian space programs have "impinged the military alone adequately and properly proceeding along in the space field as expeditiously as possible."

Sen. Stennis, who is chairing the committee of the Senate Armed Services Committee, said the nation "has no choice but to develop national, unassailable space weapons systems, if for no other reason than to ensure our potential enemies are neither and political advantages that are likely to occur in these days open only in space." He requested the present state of the space program with that of the U.S. military development at the beginning of World War II.



### Hughes Designs Model 369 for Army's LOH Competition

Modeling shows configuration of Model 369 helicopter designed by Hughes Tool Co.'s Aircraft Division for Army's Light Observation Helicopter (LOH) competition (AW May 22, p. 29). Helix and Bell were chosen to build the LOHs, but Army recently made Hughes an equal partner in the program. Army designation for the four-phase hybrid-powered Hughes helicopter is HO-6. Helix, Bell and Hill are no built five models each initially of this respective helicopter for Army evaluation.

## Army Committee Sets Guidelines For Helicopter Arming Programs

By James D. Hendrick

Washington, Va.—Army development experts have recommended as a general guideline for helicopter armament programs that no more than one type of weapon be placed on a single helicopter at any time.

This recommendation was a highlight of a report filed Aug. 15 with the commanding general of Continental Army Command, Gen. Herbert B. Powell, by an ad hoc committee composed of senior officers from CONARC and the Army Aviation Center.

The committee chairman, Maj. Gen. Thomas F. Van Natta, CONARC deputy chief of staff for combat development, observed major points of the report in the New England regional meeting of the American Helicopter Society last.

He said the committee designed guidelines with ideas which have been advanced by some military and industry agencies for "gelling a lot of weapons on one helicopter" because of weight and cost limitations.

"Some of these 'Black Panthers' ideas look very good, until you start trying to load a lot of weapons on a utility helicopter like the UH-1A with a maximum gross weight limitation of 8,500 lb," Gen. Van Natta cautioned. "It's especially difficult when you are also trying to carry one soldier above."

In an earlier talk to the society, Brig. Gen. Charles P. Van Kura, director of Army aviation, emphasized that loading helicopters with too many weapons could degrade their primary mission of troop transport.

Gen. Van Natta defined the four requirement areas for development of helicopter armament as follows:

- **Light weapons** for, mainly machine guns for directed against isolated personnel targets in areas which are effective for only about three seconds because of helicopter and/or target movement and loss of the target area.
- **Point fire**, in which rockets are directed against hardened target such as bunkers or soft targets such as personnel equipment being assembled.
- **Area fire** to destroy assembled vehicles, personnel pods and similarly grouped targets in a supplemented or complete battle for urban purposes.
- **Area fire** to destroy targets that helicopters will not "engage" entirely. He noted that this can be used for area fire, however, when troops or terrain action factors, such as a situation above a target, prevent the helicopter from being able to destroy the target because of the target's location.
- **Altitude fire**, in which the same light weapons used for personnel attack can be directed against aircraft at some altitudes. He emphasized that helicopters will not be used as air-

era fighters with faster aircraft carrying more firepower in "dogfight" situations.

Earlier, Gen. Van Natta stated that even helicopters "support" support weapons, suggesting that other vehicles and weapons will be more effective as delivery means around helicopters.

Elaborating upon the one helicopter-one weapon theme, Gen. Van Natta indicated that in some situations helicopters carrying one fire weapons (such as the SH-1) said proposal, may need rockets) might also carry light weapons of the latter type, "light enough" to satisfy VTOL weight limitations.

The noted that helicopters "will not invade the field of combat, but will support" for land forces engagements.

Developing the ad hoc committee's main purpose as an attempt to establish guidelines for single-helicopter control over Army armament studies for helicopter armament, Gen. Van Natta pointed out that in the past definition and industry agencies concerned with the program have lacked the guidance of a basic document.

The committee began work in early July and was limited by civilian and military experts involved in helicopter armament problems such as program. The committee report probably will be forwarded in the near future to the Army staff of staff's office in the Pentagon, an official at CONARC Headquarters at Ft. Monmouth, Va., said.

## Problems May Cut Polaris A3 Range Goal

Washington—Design goal of 2,500 nautical miles for the Navy's proposed Polaris A3 fleet ballistic missile is at jeopardy and may have to be abandoned, according to some officials.

In recent weeks, the Navy has been concerned by the delay, brought about by the inability of stage materials to withstand the combination of high temperatures and high chamber pressures produced by the Aerojet engines. The Navy may be forced to settle for at least 1,800 nautical miles for a shorter stage A3.

Lockheed apparently has hopes of interesting the Air Force in an A4 version, because there is some doubt that the Navy would buy a new Polaris on the basis of increased range, or range alone. Strategically, the Navy may not need a longer-range missile, because the proposed 2,100-nautical-mile A3 would enable Polaris to remain in the water for 10 days. The Navy would not need to stay in the water for 10 days.

The time of flight of a longer-range missile also would cause the reactor to become a problem.

As yet, the Navy is studying the problems which could be encountered by launch tubes of existing Polaris submarines against which there is some advance work in the state of the art of propellant nozzle materials. Although launch tubes to enable them to handle large Polaris missiles is not feasible now, because of technical problems and prohibitive cost.

Lockheed has asked Polaris contractors for contributions to the Air studies. Air probably would be a major missile, like each of the three other Polaris versions. It would use a single nozzle for the two stages, combined with low nozzle on other Polaris jets. Glow fiber driven by the second stage.

The longer range for Polaris A3 cannot be obtained by increasing the size of the missile because of missile diameter and length restrictions imposed by the size of Polaris submarine launch tubes. There had been some discussion for increasing missile length over that of the initial 1,200-nautical-mile Polaris, but this increase because has already been taken up by increasing the length of A3 to 131 ft. This greater length helps A3 toward its 8,500-nautical-mile range goal.

Now had hoped that the 2,100-nautical-mile stage might be A3, could be achieved in a Polaris submarine launch tubes, in both stages. This range was predicted on the use of a propellant that would be a hydrocarbon and has a specific heat of 1,000 ft/sec. The length of A3 is 131 ft. This greater length helps A3 toward its 8,500-nautical-mile range goal.

First stage materials used at Aerojet are A3 development approach, but not been able to withstand the 2,500° temperatures at 100 to 100 psi chamber pressure. Goal for operating chamber pressure was expected to be as high as 1,000 psi. So far there have been no completely successful tests of the stage.

Polaris the closest the company has come to a successful firing was a recent test which took 40 sec before the nozzle was destroyed.

Contracted with propellers A3 probably will cap the first stage. Aerojet propellers are more stable, but are more expensive. A3's propeller design is a gas turbine engine, however, the Aerojet propeller tends to attack.

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nozzle material, whereas A3's does not. This may enable A3, in one test experiment, more would attack nozzle materials, with lower stress requirements.

Aerojet is considering settling for cooler propellant temperatures—possibly 1,500° or 1,600°—which are estimated to shorten Polaris A3 range to 2,500 nautical miles. Comparing bearing temperatures for the 1,200 nautical mile A1 is about 1,400°.

Navy may have to settle for 2,300 nautical miles unless A3 can improve performance characteristics.

### Management Shifted

In an effort to correct the problems it has encountered with the A3 first stage, Aerojet has shifted management of the program. Manager of the second stage project, which has been going along on schedule, recently was put in charge of the larger first-stage development. Manager of the first stage was then put in charge of the second stage.

Problems with the second stage have not been as severe as those with the first stage. The combination of test pressure and chamber pressure are much lower in the second stage. The initial thrust of the second stage is about 1,800 lb less than that of the first stage, and chamber pressure is only about 134 psi.

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## AIR TRANSPORT

# Passenger Fare Cuts Expected to Spread

Industry hopes to arrest downward swing in traffic but splits over what types of special rates to use.

By L. L. Day

Washington—Current rash of airline passenger fare reductions, introduced only 18 months after a successful campaign to raise the general fare level, is now expected to spread even farther as a means of arresting the downward swing in passenger traffic.

Procedural delays filed with the Civil Aeronautics Board in the past few months—now totaling 13—have been a windfall to the passenger but have split the industry wide open in disagreement over the type of special rate that will open new markets and generate a larger volume of business. The new fares have transferred airline ticket offices into business sales counters which offer today's traveler a wide variety of weekend-two days.

Among with little apparent hope of expanding first-class business, which has remained virtually static in recent months, airlines now are focusing attention on surface traffic in the volume of the next major travel market. Chief question to be answered, and the origin of industry disagreement, is which of the new fares will actually develop new traffic instead of merely diverting existing traffic to lower fare categories.

Another industry factor is whether the lost fare income granted the airlines by the Board in June of last year may have been an underlying cause of current traffic depression. The fare increase of approximately 5% closely coincided with the beginning of the softening off of passenger income sales (AVT June 27, 1960 p. 41).

It also was in June of last year that coach traffic first began to replace first-class traffic in the domestic share of an airline. In July of this year, coach accounted for more than 52% of all traffic handled by the airlines, compared with 54% in July of 1959. The upward trend has been consistently repeated.

A majority of industry officials feel, however, that the traffic depression is due to such causes as the general economic condition of the nation, the end-of-the-summer vacation sales slump, and the surge of available seat miles coming from the introduction of the jet and the strong possibility that the present air travel market has been all but saturated.

To offset these factors, industry now feels that promotional fares must be used to develop new markets. Elsewhere the facts that have been introduced within the past five months to achieve this goal.

• **Yield fares.** A 50% reduction on basic first-class fares restricted to passen-

gers between the ages of 12 and 21 or Reservations may be made only within the 14-day period before flight time. Eastern, Pan Am, and Pacific have complaints with the Board regarding investigation and suspension of the fare but the Board designated the complaint and approved the fare.

• **TWA executive fares.** A non-transferable round-trip fare of \$1985 as jet aircraft and \$1775 on propeller aircraft. Travel is restricted to the period between February 15 and 12 noon. Eastern, Eastern, Pan Am, and Pacific have complaints with the Board regarding investigation and suspension of the fare but the Board designated the complaint and approved the fare.

• **Broccoli night coach family plan.** Accompanying members of the head of a household are entitled to a 35% dis-

count when using Broccoli night coach trips.

• **Airline executive service.** The first of several rates, no-fuel, no-transportation, no-connection.

• **Eastern Air Lines air shuttle.** Extension on the line, shuttle service between Boston and New York and New York and Washington. No connections are accepted, no extra are offered the passenger. Fare is about 14% to 20% lower than present.

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• **Milwaukee golden age fare.** Women 62 or older and men 65 or older are eligible to join the golden age group by paying a membership fee of \$5. Milwaukee and airlines members to an appropriate 50% reduction of one-way fares on Milwaukee routes.

• **Bonanza airfare.** Bonanza has filed for a tariff that would permit passengers to indicated travel as the Bonanza system for 15 days at a full rate of \$90 or 30 days at \$480. Only travel on flight outside the Bonanza system would qualify for this special fare and require a non-transferable ticket.

• **Bonanza youth fare.** Bonanza offers a round-trip fare for all youth between 12 and 21 without restrictions on reservations. Purchase of an annual youth identification card for \$2 is required to qualify for the low fare.

• **Trans-World round-trip tickets.** Car set but not yet to standardize travel on short-haul routes such as between Los Angeles, Chicago, and New York.

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## Lockheed C-41 Design Undergoes Pressure-Distribution Test

Pressure-distribution model of Lockheed C-41 cargo transport for military and civilian roles is shown being mounted and tested in General Aeronautics Laboratory's transient tunnel. Tests will produce data for structural design of the full-scale airplane. Two models have been tested in the program: a Lockheed-built model and the Cornell H model, comprising two and one-half feet and one-half inch.

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A technician at the 42 subsystems incorporating 3500 electronic parts which go into TIROS II is one of many who service all components, must be thoroughly tested, precisely measured and must function properly at the satellite in its performance successfully.

## NASA's Hurricane spotting TIROS III maintains projects' fine performance record

With the successful launching of TIROS III, meteorologists for the first time will see the total cloud formations and measure the radiative energy balance of hurricanes which plague the eastern coast of North and Central America each year. For TIROS III was launched at this time for precisely this purpose. From information gained from TIROS III, meteorologists may learn much more about the birth and life cycle of tropical storms.

### TIROS III DESIGN

Although the spacecraft configuration is essentially the same as the previous two highly reliable TIROS satellites, TIROS III has two wide-angle cameras and the National Aeronautics and Space Administration has placed new astronomical IR sensors aboard to measure thermal radiation from the earth and sun.

### THIRD OF A FAMOUS FAMILY

TIROS III is the third of a highly successful series of experimental weather satellites which were developed, along with the associated ground equipment, by the NASA, under contract with the Goddard Space Flight Center, by RCA's Space Center. All of them have established "firsts" in the United States' space program.

TIROS II established a longevity record for a complex satellite. Still operating after nearly eight months and over 3900 orbits, TIROS II has transmitted over 54,000 photographs to the ground. Aside from its impressive meteorological achievement, NASAmen may well point to the long-term performance as the first to prove that a satellite system could operate reliably for so many months in a space environment thus proving the feasibility of operational satellites.

TIROS I was the first satellite, carrying advanced television equipment, which sent photographs of the earth's cloud cover to meteorologists. From TIROS I's 23,000 photographs, meteorologists found that satellites could be used for weather observation and analysis. The potential information is particularly useful in the two-thirds of the world from which few or no weather observations are now available.

### CONNOTATIONS FOR THE FUTURE

The TIROS series has proved beyond a doubt that the peaceful uses of space will benefit all mankind. So far, nations participated in the utilization of information from TIROS II and more will take advantage of TIROS III. RCA is already at work on the camera systems and space power supply for Nimbus, the next generation of meteorological satellites.

If you are a professional physicist, engineer, or mathematician and interested in participating in such challenging projects and stimulating team efforts, contact the Recruitment Manager, RCA Aeronautics Division, Defense Electronics Products, Princeton, N. J. All qualified applicants are considered regardless of race, creed, color or national origin.



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## Class Mail Rate Subsidies Raise Local Carriers' Profit Potential

Washington's profit potential of local service operations took a sharp jump upward in the second quarter of this year when the Civil Aeronautics Board's new class mail rate status of subsidy practices.

The removal of all 15 local service airlines from taxpayer aid status, which provided each licensee subsidy awards and their placement on local rates under the new status generated operating profits totaling over three \$4.4 million for the quarter, compared with a \$215,771 operating loss for the same period last year.

Realizers noted at the carriers as the second quarter increased only 4.3%, for a total of \$12.4 million. Total airline profits made in this quarter

amounted to \$1.56 million, an increase of \$1.8 million over the same period of 1960.

Commercial revenues raised by the carriers were up \$3.6 million and accounted for \$29.2 million of the industry's \$45.2 million in total operating revenues. Total operating expenses worked \$41.9 million for a gain of \$15.8 million over the second quarter of last year.

Based on a flexible formula that is in airline contracts for the national class plane rates per station, the new class rate system has retarded the rate dramatic price progress in an number of operating profits expressed in cents per average plane mile.

Most, then, half of the local service

operation were able to receive second quarter losses, which ranged from \$12 cents to 20.41 cents per average plane mile, to operating profits reaching four 12.71 cents for Central Airlines to a high of 27.05 cents per average plane mile for Mohawk Airlines. Laker Central increased its average profit from 4.07 cents in the same comparative period to 5.87 cents in the second quarter of this year.

### Operating Losses

Four other carriers—Trans-Texas Airway, Overl, Air Lines, North Central Airlines and Frontier Airlines—maintained operating losses ranging between 2.34 cents to 6.52 cents, primarily because of varying dates of application of the new rate and adverse weather conditions which affected their operations during the quarter.

Although these figures are increasing and should place several carriers on the profit showing phase of the class mail rate, industry observers point out that expected CAB changes in the formula may reduce this rate of profit growth.

## Minimum Air Freight Rates to Be Revoked

Washington-Civil Aeronautics Board has ordered maximum rates for domestic air freight, including assembly and distribution services, to be revoked on Oct. 3.

The Board took the action after noting that competition, leading to the establishment of the original maximum rate for cargo in 1938 no longer exist. In 1948, the domestic truckload and the air-cargo carriers were engaged in a rate war that caused CAB to set the maximum.

The Board also noted that for an air mail surcharge, domestic cargo rates have been stable. In 1957 the carriers voluntarily filed for general rate increases of 16%. Since then, freight rates have been well above the CAB prescribed maximums.

In revoking maximum rates, CAB said carriers it would not permit rates to fall below economic levels or permit the type of competitive practices which forced establishment of rate floors as the first phase. After Oct. 3, rates will be subject to the rate of market competition or to suspension or investigation upon complaint or on the Board's initiative.

The Board said there is prospect of a breakthrough in air freight transport volume with new routes and competitive profitable for the first time. New capacity in the form of jetliners, proposed all-cargo aircraft offering greatly increased capacity coupled with existing ground equipment thus promise of economies.

## Carrier Operating Profits

Local service airlines sorted by increase in operating profit second quarter 1961 over 1960

(cents per average plane mile)

Operating Profit (Do Last)

CARRIER	1960	1961	Second Quarter
Pacific	1	41.46	120.42
West Coast	2	34.12	101.07
McCarroll	3	30.47	97.46
Golden	4	33.43	120.42
Boeing	5	32.12	97.46
Allegany	6	30.47	97.46
Central	7	30.47	97.46
Frontier	8	23.38	100.00
Lake Central	9	14.00	4.00
Overl	10	12.12	12.12
North Central	11	12.12	12.12
Frontier	12	10.12	10.12

## Comparative Operating Results

Electronic local service airlines—comparison of operating profits second quarter 1961 and 1960.

Second Quarter	1960	1961	Increase
Revenue:			
Passenger	\$21,100,334	\$21,100,334	\$0
M. & Mail	479,341	480,334	1,000
Freight	1,103,872	1,270,419	166,547
Other Commercial	460,564	481,239	20,675
Total Revenue	\$23,144,011	\$23,152,326	\$8,315
Operating Expenses	\$21,100,334	\$21,100,334	\$0
Total Operating Expense	\$21,100,334	\$21,100,334	\$0
Profit (or loss)	\$2,043,677	\$2,052,000	\$8,323
Operating profit	\$21,100,334	\$23,152,326	\$2,052,000

Prepared by Ray and Ray

**BS**

# **BRISTOL SIDDELEY AERO-ENGINE APPLICATIONS**

**Olympus turbojet power...**  
Arco Valon Mk 1 & 2 V bomber  
SAC T80 2 turbofan turbo-prop

**Rapace turbofan power...**  
Beech F107 VTOL strike aircraft  
Fokker Republic Y-TOL fighter

**Rapace turbojet power...**  
Gloster Javelin all weather fighter  
Beechey Pogo V-400 V-bomber

**Olympus turbojet power...**  
F4U Corsair fighter  
F4U Corsair  
Folland Gnat light fighter  
Folland Gnat trainer  
Fokker T10 2 trainer  
Hawker Siddeley HS 10 fighter

**Viper turbojet power...**  
De Havilland Jet Dragon maritime transport  
Fokker D-100 100-100 maritime transport  
Hawker Jet Provost trainer  
Mikoyan MiG 19 fighter  
GAF Puma 4-engine transport

**Pratt & Whitney power...**  
Dassault Mirage fighter  
Dassault Mirage fighter

**Three engine power...**  
Dassault Mirage fighter

**Olympus rocket engine power...**  
Beechey Pogo V-400 V-bomber

**Bombardier rocket engine power...**  
Arco Star Steel stand off bomb

*Airliners, transports, trainers, bombers, fighters, missiles, space probes—in service all over the world...*

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# Airline Income and Expenses—June, 1961

IN DOLLARS

	Passenger Revenue	E & B Mail	Expense	Weight	Charter	Total Operating Revenue	Total Operating Expense	Net Income Before Taxes
<b>DOMESTIC TRAFFIC</b>								
American	16,038,304	449,734	370,148	2,233,470		29,744,721	24,889,719	4,855,002
Continental	5,292,274	145,244	49,457	523,718	24,734	6,895,257	4,721,774	2,173,483
Eastern	2,334,002	57,000	42,000	167,000		2,433,002	1,941,000	492,002
Delta	13,764,509	324,000	123,000	1,020,000	57,000	19,749,719	15,924,000	3,825,719
Northwest	12,845,474	199,411	1,070,738	1,070,738		12,845,474	12,845,474	0
Southwest	3,281,202	117,811	55,614	208,137	136,333	3,584,000	2,861,457	722,543
Trans World	4,730,200	22,000	13,171	55,171	45,891	4,791,261	3,779,171	1,012,090
Western	7,431,361	112,073	426,811	10,201	5,329,204	6,860,439	5,400,407	1,460,032
Trans World	26,211,479	493,437	1,470,441	14,320	20,950,734	27,741,479	26,241,479	1,500,000
Western	49,412,000	1,498,020	339,000	199,000	36,447,199	86,146,199	84,648,199	1,498,000
Western	5,271,793	97,137	220,351	97,137	3,794,333	5,271,793	3,794,333	1,477,460
<b>INTERNATIONAL</b>								
American	413,769	7,130	67,600			544,000	544,000	0
Continental	939,479	27,353	48,351			1,015,182	1,015,182	0
Eastern	373,709	3,199	14,363		4,704	381,171	381,171	0
Delta	148,200	7,000	4,000			159,200	159,200	0
Northwest	2,654,700	64,327				2,719,027	2,719,027	0
Southwest	19,700					19,700	19,700	0
Trans World	3,018,147	192,100	109,191	48,541	4,637,939	3,617,474	3,617,474	0
Western	16,491,000	1,320,000	2,754,000	1,262,000	42,149,000	52,149,000	52,149,000	0
Trans World	300,000	20,000	20,000			320,000	320,000	0
Western	17,764,000	1,120,000	1,440,000	447,398	4,637,939	19,124,137	19,124,137	0
Southwest	7,768,000	320,000	160,000	160,000	5,848,000	13,848,000	13,848,000	0
Trans World	9,647,000	1,110,000	1,680,000	520,000	11,746,000	13,326,000	13,326,000	0
Western	1,322,000	63,000	248,000	16,890	5,746,000	6,137,890	6,137,890	0
Southwest	35,767	347	1,000			36,114	36,114	0
Trans World	7,767,013	480,330	820,330	125,642	8,663,280	9,704,280	1,041,000	0
Western	402,120	2,334	12,914			415,134	415,134	0
<b>LOCAL SERVICE</b>								
Allegiant	1,323,497	22,294	31,969	49,044	5,347	1,343,471	1,343,471	0
Continental	465,000	3,978	2,968	7,977	1,841	473,856	465,000	8,856
Delta	367,493	15,407	2,120	14,001	1,929	387,929	387,929	0
Eastern	1,645,011	6,000	26,453	267		1,671,521	1,671,521	0
Northwest	248,960	9,712	10,719	18,714	1,637	269,028	269,028	0
Southwest	1,726,040	12,444	10,263	28,710	20,011	1,787,468	1,787,468	0
Trans World	34,240,000	34,000	34,000	1,000	1,000	34,240,000	34,240,000	0
Western	771,493	16,235	8,011	35,565	1,490,744	1,117,178	1,117,178	0
Southwest	275,000	16,000	10,000	10,000	10,000	291,000	291,000	0
Trans World	116,449	10,371	6,108	12,320	20,181	135,329	135,329	0
Western	317,101	17,450	4,440	7,440	3,471	331,462	331,462	0
Southwest	331,423	14,779	4,963	16,108	26,363	363,536	363,536	0
Trans World	408,204	8,162	2,708	14,904	1,844	435,720	435,720	0
<b>INTEGRATED LINES</b>								
Alaska	421,260	3,798	4,438			429,480	429,480	0
Western	257,207	2,437				259,644	259,644	0
<b>CARGO LINES</b>								
Continental	291,644	393,264	644,878	79,799		1,019,585	1,019,585	0
Delta						103,740	103,740	0
<b>HELICOPTER TRAFFIC</b>								
Continental	126,632	321,214				297,180	297,180	0
Los Angeles Airways	79,684	12,128	12,282			140,299	140,299	0
New York Airways	105,648	3,790	2,444	4,172		111,164	111,164	0
<b>ALASKA LINES</b>								
Alaska Airlines	223,690	41,499	1,347	21,724	373,761	620,121	620,121	0
Alaska Coast	126,220	4,283	11,504	5,266	108,446	245,240	245,240	0
Alaska Coast	9,600	2,000	26,146	149	121,861	139,616	139,616	0
Delta	73,300	4,791	8,400	1,100	1,100	83,600	83,600	0
Western	10,000	689	1,000	10,000	10,000	21,689	21,689	0
Western Coast	116,444	10,000	10,000	10,000	10,000	136,444	136,444	0
Trans World	162,827	22,367	3,944	133,841	1,202,320	1,499,449	1,499,449	0
Trans World	165,115	11,421	4,260	133,841	1,202,320	1,499,449	1,499,449	0
Western Coast	15,411	4,260	1,202	11,130	33,316	65,214	65,214	0
Western Coast	149,772	22,367	3,944	133,841	1,202,320	1,499,449	1,499,449	0

1. Delta's figures include domestic and international income and expenses.

2. Western's figures include domestic and international income and expenses.

3. Western's figures include domestic and international income and expenses.

4. Western's figures include domestic and international income and expenses.

5. Western's figures include domestic and international income and expenses.

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8. Western's figures include domestic and international income and expenses.

9. Western's figures include domestic and international income and expenses.

10. Western's figures include domestic and international income and expenses.

## SHORTLINES

► Chicago Helicopter Airways, releasing 17 of its scheduled operations, is posted it has flown more than 6.2 mil hrs scheduled miles in the period.

► Federal Aviation Agency has called a conference for Sept. 11 at Washington to discuss means to regulations governing performance and operation of airline-powered aircraft. Those planning to attend should notify FAA by Oct. 10.

► Federal Aviation Agency has issued the ceiling of the Chicago-Milwaukee route control area from 15,000 ft to 10,000 ft. The new ceiling will give protection of positive control to the performance and will reduce aircraft operating above 15,000 ft. Review of this will remain at 24,000 ft.

► Japan Air Lines reports earnings of \$76 million for July, an increase of \$347,421 over the preceding month.

► Lake Central Airlines will serve Macomb, W. Va., on its Washington D. C. to Charleston, W. Va., and Cincinnati-Washington-Baltimore route, beginning Oct. 29.

► Lockheed's Jetstar 300 jet transport test work needs both type and production certificates from Federal Aviation Agency. The aircraft powered by four Pratt & Whitney JT12 turbo jet engines, carries eight passengers at speeds in excess of 500 mph.

► Northwest Airlines is carrying line of its DC-7s to DC-7CP by brightening the aircraft's paint.

► Panair has begun service with Douglas DC-7 transport aircraft between New York and Georgetown, Guyana. Scheduled flights for one round trip per week leaving New York on Thursdays and returning on Mondays.

► Trans World Airlines has added the Civil Aeronautics Board for permission to sell "open pass" tickets under the combined round-trip excursion rate plan. Under the arrangement, passengers may fly from New York to Los Angeles and return to New York from San Francisco.

► United Air Lines has repurchased 6 of the 15 Vickers Viscounts that were returned to the manufacturer when the airline merged with Capital.

## AIRLINE OBSERVER

► With the Federal Aviation Agency's Project Tighthead report to accompany issuance of a "blue ribbon code" of FAA accident investigation who would be subject to the score of safety audit transport aircraft. The serious accident was followed by a broader FAA rule in accident investigation, now statistics assigned to Civil Aeronautics Board. Project Tighthead, first, is headed by Lloyd N. Carter, a Washington lawyer, and was intended to develop better methods for studying and enforcing an safety regulations.

► Domestic airline common stock continued to decline last week, a sluggish condition which has prevailed for the past few weeks. On one occasion last week, American Airlines was the most active issue on the New York Stock Exchange with a turnover of 140,000 shares, although the loss that day was not final. Early last week, TWA common stock hit a new 1961 low. Recent lack of investor interest in airline stock is illustrated by Wall Street's first-fifth closing of the domestic airlines.

► Refusal to transport agreement with the Soviet Union, negotiated and then scrapped last month after the border between East and West Berlin was sealed in the East German Government, continued a climate in which the Russian agreed in principle to conform with International Civil Aviation Organization technical standards. ICAO, however, was not interested. A political agreement between the two nations, New York, and London, the two nations selected to be the Moscow New York route, Inland German, Spanish, China and Stockholm on "technical stops." Both nations were to operate two flights per week between the two capitals, with Aeroflot using an Tupolev Tu-14 and Boeing 747-100 transport, the latter found with extra fuel tanks.

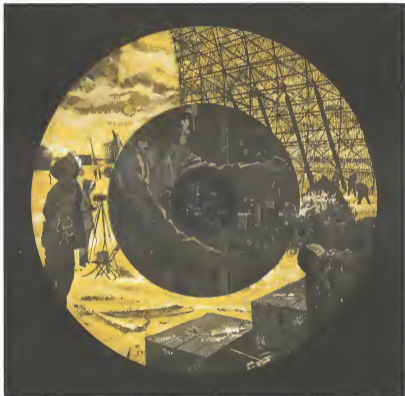
► Flying Tiger Line will purchase five Canadian CL-44 turboprop cargo transports in addition to the 10 it has on order if it can arrange Mexican financing. Carrier plans an initial shipment of 10 by per month, going eventually to attain a goal of 16 by December, a being given by Flying Tiger President Robert Pearson to stage the CL-44 in transatlantic charter service, carrying 219 passengers at a round-trip rate of about \$89.

► Trans World Airlines has been granted a 200-hr extension of its route between Omaha to LBJ on the Pratt & Whitney JTIC-6 turboprop engine.

► Eastern Air Lines has increased its New York-Washington commuter service to provide over-the-horizon bus service between 7 a.m. and 10 p.m. By the middle of this month, Eastern will have a total of 22 Lockheed 1049 Constellation converted to 55-seat configurations for this service. Since service began on April 16, 95,000 of all flights have operated easily on schedule, 95,170 on time within 15 min. of schedule.

► Russia's Aeroflot has inaugurated regular service over its far northern route from Moscow to Chukotka in extreme northeastern Siberia via the Khatanga Sea port of Tiksi. B-18 turboprop transports are making one round trip weekly over the line, most of which is above the Arctic Circle. Flights time is 11.5 hr. Moscow-Chukotka, going from Khatanga, has been suspended, the route was cut off with the remote Chukotka, Nenets, Duma to the Soviet, through Magadan and Khatanga.

► Component proposals, offered by the Russians to Japan as a first step toward opening an air route between Moscow and Tokyo (AW Aug. 28, p. 32), have now passed through the Transportation Ministry has refused to accept a suggestion by Soviet Deputy Premier Nikolai Khrushchev that Russia will agree to direct service between Tokyo and Moscow on condition that Soviet pilots from Japanese transports between Khatanga and the Russian capital. Explaining the condition, Moscow said that, "to be frank, Japan has concluded a military pact with the United States and there is the danger of Japanese aircraft taking photographs of Siberia." It also said there is a fear that these pictures might get into U.S. hands.



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## Rolls Increases Turbine Engine Experience

London—Problems with Rolls-Royce commercial gas turbine engines have followed the expected pattern of new designs, starting from the well-known phenomenon that delayed the Trium to begin to the more serious of the Avon debacle.

Currently, no major problems remain unsolved. Rolls-Royce has now engineering solutions and test programs to operations, and fitted five into production engines on the line with minor snags.

## Turbine Engines

The company's gas turbine engines—both civil and military types—have racked up the impressive total of 27 million hr of flight time. Most of this figure is credited to the early test of the Dart turbo-prop in successful use.

use with the engine. Current commercial output has met total times approximately 10 million hours for the Avon and about one-quarter of that for the Conquest.

Time between overhauls (TBO) has been calculated for each of the engines. When the Dart entered commercial service in 1951, its initial TBO was 400 hr. Current figure is 3,000 hr. The Avon, which started at 1,000 hr in the Conquest in 1948, is now approved in the Avon Registration Manual for 2,700 hr and selected engines are being allowed to reach 3,200 hr, a step toward a further increase in TBO.

The Conquest engine, which also began flight in 1948, at 1,700 hr, now, with trials under way, is increasing this to 3,500 hr. Rotating and blade problems have been the major deficiencies experienced

by operation of the Conquest before engine. During 1962, 513 hr in service up to June 18, 1962, over all rate of engine shutdowns in flight for Conquest was 0.0003. During 1970, it was one per 9,400 hr of operation, and the average for all engines was one per 6,000 hr of operation. Rolls is still recording DCA data and latest current figures are not available.

About one-third of the shutdowns were inoperative to engine or track defects in front and rear bearings. Metal particles collected in the oil filters and were detected, showing significant bearing failure; before the total failure could occur. Worst offender was the front low-pressure compressor bearing, which was having trouble spinning and lock failure of the cage. A modification to the bearing housing solved the problem.

## Center Bearing

In the case of the center bearing, however, in the center of the bearing, the cage. This defect was also corrected with the engine from one more bearing only, and has been cured by making cages to a single specification.

Rolls has two remaining incidents of oil-film compressor blade failure in two sections of the high-pressure compressor. First stage blades experienced resonance due to shroud induced by the weakness of the low-speed engine after prolonged ground running, or shroud or low speed. Fix was to change the natural frequency of the blade.

Major serious problems affected the fifth, sixth and seventh stages of the high-pressure compressor. On the one hand, the profile of Douglas DC is actually very rounded, and this also led to the fix. The trouble started during full thrust running on the ground, a fact the overhaul engineers suggested the relevant signs of the relevant power plants, and then staged blades. The engine turned right frequency and failure of the compressor blades. This was corrected by a structural change, which restricted engine thrust to 50% only on the overhauled engines except in emergency.

As of last June 16, the Conquest's average rate of unscheduled shutdowns per 1,000 hr, among that rate is no index of one, was 36, a drop from the peak reached in October, 1968, of 48. This compares with the Dart average rate of 23.5. Although, which operates like Conquest powered DC-8s, had an unscheduled shutdown rate of 21, per 1,000 hr. As of last May, Trium-Canada operations

of 10 DC-8s powered by Conquest, had a somewhat higher rate as of last April, it was 59 per 1,000 hr, a data from the peak of 79 recorded last December. Operation using Conquest-powered 70% have achieved a rate of just under 10.

Rolls and that between April, 1960, and June, 1962, there are 75 unscheduled shutdowns of Conquest in a total of 245,415 hr. Six unscheduled failures of the low-pressure compressor front bearing and since the fix, increasing clearance of the bearing, there have been no more of this trouble. In the case of center bearing failures, which is valid test engines, there have been no failures since the modification.

## Nimrod 105

On 15 engines involved because of difficulties with high-pressure turbine blades, the fix was replacement of Nimrod 105 blades of overhauled with Nimrod 105, and all new engines now are being built with the latter also. As of June 30, a total of 12,123 hr has been flown by Nimrod 105 and there have been no failures.

Rearcase of 10 engines were attributed to the high-pressure compressor blade and Rolls suggested that operation last amount of running time in the 5,000 to 7,000 rpm range, and began modifying the blade angles. There have been no failures of engines with such failure since a three-month period prior to June since the previous standard.

In the case of trouble with the fifth stage compressor blade, with one several blades on that section, the fix was to increase the clearance between the rotor and stator. There have been no failures since the fix was ordered but no failure of engines with such failure have occurred.

Oil consumption was another trouble area, since the specification allows only 0.9 of a quart at the consumption rate. There were two examples of oil consumption which exceeded this factor and to fix it. Rolls altered oil clearance. Engineers are making checks on test stands at specific rpm ranges, and a new oil control development testing. There have been no failures since the fix and clearance was changed.

## Various Problems

In 20 other unscheduled incidents, the problems were varied. For instance, three were due to center bearing tips, another due to bearing of the low-pressure compressor blades, and those others due to vibration. Other failures included a nose stage breakdown, failure of the internal shroud and the shroud drive, and in one case, an oil-bearing condition.

First 200,000 hr of Avon engine flight time was not met by a single unscheduled shutdown due to engine failure.

## Trans-Canada Conway Experience

Trans-Canada Air Lines, one of the major users of the Rolls-Royce Conway bypass engine, could not meet additional trouble, experienced with that engine as a result submitted to the Society of Automotive Engineers by J. F. Dwyer and J. J. Edey of the airline. TCA points out that it entered the program only by buying an engine that had not accumulated substantial engine time prior to delivery—operating during the first month of engine time, operating this, was very rare even in the engine's development history—TCA also had bought to initial operational development period.

The company took the risk because of its previous experience with Rolls-Royce, trusting in the ability of the engine company to analyze rapidly component problems and to make the necessary firm quickly.

TCA was told that the Conquest is over the hump and will probably approach the Dart in reliability.

The Canadian airline outlined these problems:

- Front bearing housing wear caused due to race clearance, the engine was again subjected to a rate of 70 rpm and 100,000 (7070). The problem was solved by the addition of a shim with roller while keeping the bearing and bearing edge of the case due to its wear.
- Turbine blades showed large surface in stability. Three Nimrod V5 high-pressure turbine blades (three of four blades) from 1,000 hr. time on the engine. TCA noted that stability as DC-8s used tookoff power for two minutes, but that acceleration rates reduced this time to less than one minute. The airline could not avoid procedures with relieving the blade situation, and says the in-flight blade will not even stabilize at the gas temperature during such a short takeoff power surge. TCA is replacing these blades with new ones of Nimrod 105, which the airline says are likely to give substantially better operation than the Nimrod V5 blades in Dart operation.
- High-pressure turbine compressor blades failed on the outward surface of the DC-8s in use with other operators.

TCA calls that "batteries" in having only low high-pressure compressor first stage blades, compared with other operators. They attribute the failure to assistance in testing and shroud angles, and say that operating restrictions in these cases have been imposed to make a temporary fix. Modifications will remove the batteries.

Low-pressure compressor front bearing problems caused 11 engine overhauls during the first year of TCA operation. Modifications have solved the problem, the airline says.

A fuel pump failure caused eight unscheduled engine overhauls during TCA's first year. In addition, TCA recognized all fuel pumps which had not been inspected by its own shop. The airline said that it would be sending the shop of 400,000, and the manufacturer's inspection center and technicians. Upward steps have been taken by the manufacturer, plus a modification proposal to get the pump right. TCA says the fuel pump is difficult to inspect right pipes difficult to remove, and access to it is made difficult by a proximity of the lower part of the nose cone which holds work on the pump from below. Rolls is studying the pump and the shop of 400,000, 51 hr, for a normal overhaul change, including the pump run, it takes about as long to change a fuel pump on the installed engine.

Rolls reports that two new random engine overhauls. The first was on a Conquest power plant, which cracked under complex loading, and was fixed by a modification which shifted 41° internal frequency. The second problem was with deterioration of oil seals in the gearbox during and was early solved, presumably by a structural change.

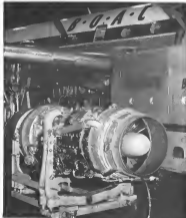
Out of a total of 1,065,142 hr of test operation in June 30, there have been 97 engine shutdowns. Conquest, there have been 10 unscheduled shutdowns.

Unscheduled engine overhauls for both engines in about one per 5,000 hr. Rolls said that there have been no major problems in higher overhauls Avon power plants. Alberta and Solomons. Conquest,

equipped with the 12,300-hp thrust Mk. 514 or the Conquest Mk. 512, also of 12,300-hp thrust.

About a year ago, a Type turbine disk burst during static testing at a test house the Victoria Vanguard, powered by four Triums, was just about to be completed. Follow-up inspection of every Type that had been flown) took one other disk in bad shape; it had a crack radiating out from the face.

The problem, it was said, was not confined. Follow-up inspection of every Type that had been flown) took one other disk in bad shape; it had a crack radiating out from the face. The problem, it was said, was not confined. Follow-up inspection of every Type that had been flown) took one other disk in bad shape; it had a crack radiating out from the face. The problem, it was said, was not confined. Follow-up inspection of every Type that had been flown) took one other disk in bad shape; it had a crack radiating out from the face.



ROLLS-ROYCE AVON RA 39 turbo-prop is currently certified by the Air Registration Board for 2,700 hr. TBO in the Hercules Const T75 and C models.



## ALCOA CAPABILITY AT WORK . . .

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## Vulcan Undergoing Skybolt Compatibility Tests

Artist's conception of Aero Vulcan B Mk 2 bomber in Red Air Force shows undergoing testing and early Douglas Skybolt air to surface missile, which will be attached to a wing pylon. Vulcan is undergoing Skybolt compatibility tests in the U. S. Government test for missile compatibility system being developed in the U. S. by Associated Electrical Industries.

for the turbine and the last two stages of the high-pressure compressor.

Changing the manufacturing process eliminated the chance of uncontrolled physical properties taking over and creating a dangerous situation.

Disk profile and content have been kept in the new approach, but the disk quality is controlled by vacuum sealing, and the length diameter ratio of the hub has been increased so that loading it during forging results in some hot-working of the material. This in turn improves grain flow (AWM Jan. 30, p. 37).

Tyne overhead line is still 400 lb.—the most as it was when it entered service. Three major flaws have been made and British Aerospace Airways' engines now are being tested at 400 lb. and Trans-Canada at 750 lb. Rolls are given until the T80 rate should be 1,600 lb. early next year, and 1,200 lb. by the end of 1962.

Aside from the disk failures, which Rolls has not as much as what would have been caused by the fact that the main bearing has been in failure of the jet bearing at the aft end of the coupling shaft in the intermediate section, after excessive vibration. Rolls is improving the engine balance characteristics on the production line, but have to see to redesign the tail bearing.

The standard six "slotted" type bearing in which the rotor allows the bearing to move against its outer ring, spring-loaded tapered metal plates. Rollins is aware the center of gravity of the shaft section thus its geometric center, and vibration damping has been considered, the engineers said.

Acoustic problems are now the bearing in the high-pressure sections, where concern of the noise tended to dig into

moving parts. Rolls at the center has been successful to eliminate this trouble. Bearing bags accounted for 90% of the unscheduled removals but Rolls and this has dropped to 30% since the start.

Oil consumption higher than the specification of one pint per hour, the same as the Dart, was another problem plaguing the Tyne. Rolls discovered that the piston ring type of oil seal used in the high-pressure section was not successful and has since changed it to a thrust seal on all engines.

## Shredding Flares

Shredding pieces around the first stage rotor blades had a history of causing and Rolls fixed this by looking up the shredding shaft.

Another important reason for operator troubles with the Tyne is the low life of the Tyne's flame tubes, now set at 350 hr. Carbon buildup on the nose was disturbing the flame pattern, and Rolls now is washing the nose with fuel, rather than with air as before. Flare also was burning the tube edges as Rolls turned to a solid cast in that section. These tubes now going on all protection capacitors have had the entire pipe beaded up and the air tubes are being modified.

On Tyne with the bearing Bore, 45 now are in service (15 with TCA) and they have flown 7,500 hr. with no bearing failures. Rolls flew 450 hr. of tests on the tail bearing alone, after up to 18 hr. per day before making the final change.

Compressor seal it is up to progress on delivery of Tyne, and ahead on delivery of spares. In the event an operator finds it necessary, Rolls says it now can lose engines where needed.



## WORLD'S MOST EXTENSIVE ALUMINUM JOBING FACILITIES . . .

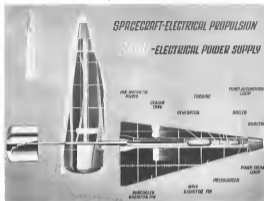
The small aluminum globe in the picture is a barrel. Alcoa engineered and developed for the U. S. Army Chemical Corps. The mill tubes in the right are 2000 series outer shells. The grooves that resemble chess pieces are center supports of the Air Force's Polioop missile. The drums are chemical shipping and storage containers for the armed forces. The cylinders on the left are evacuation tank tubes for Army Ordnance's M-40 tank.

Not shown are rocket engine cases, turbine casings, jet fuel filter separators and scores of other defense items Alcoa turns out by the thousands.

## UNMATCHED FACILITIES

Alcoa's facilities for aluminum production are unmatched in the world. Alcoa's worked with aluminum longer, using so many techniques, in so many plants.

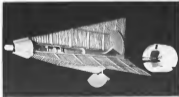
Alcoa's Press Department can draw, blow, form, stretch, and look same. Its joining Section can spot, seam, flash and arc weld or rivet—no one is better equipped to specify joining techniques and proper alloys. Furnace facilities include the tools to bond, form, cut, drill, turn, bead and rout. Engineering, finishing, testing, inspecting—Alcoa can help with everything from design to finish. How can you use this capability? Write: Aluminum Company of America, Jobbing Division, 1670-J Alcoa Building, Pittsburgh 19, Pa.



DESIGN of the proposed Spur Space power reactor in an electric sodium reactor propelled spacecraft shows the shadow-shielded nuclear reactor at right, the two-phase energy conversion circuit and the turbo-generator. Near the middle of the tubular body is the tank of sodium fuel for the sodium reactor. The tubular body is divided into sections: REACTOR, TURBOGENERATOR, CONDENSER, BOILER, and HEAT EXCHANGER. Other components labeled include AIR INLET/OUT PORTS, CLEAN TRAIL, PUMP/REGULATOR LOOP, PRESSURIZER, and POWER DEMAND LOOP.

## Spur Nuclear Space Powerplant Proposed

By Russell Hawkins



SPUR model made by General Corp., Aerospace Division shows a tubular body containing the propulsion system components: the turbo-generator and the two-phase sodium reactor power conversion loop to drive the turbine. A 3,000-hp. unit could be used for prototype tests in 1966 according to a USAF study, and a 1,000-hp. unit is projected as an outgrowth of the program. USAF funded earlier sodium studies in 1958 and 1959.

USAF study of Spur began joint work reactor) nuclear turbo-electric powerplant for spacecraft soon, drawing to a close indicates that the 180-hp. unit could be used for prototype tests by early 1966 if the government will invest about \$50 million in the project over the five-year period.

Spur has a 1,000-hp. (one megawatt) potential. The 300-hp. version has applications for space missions planned in 1970 or earlier.

USAF, with the cooperation of the Atomic Energy Commission, awarded the prime contract for the Spur study to General Corp.'s Aerospace Division. Cabinet studies of the system were funded by USAF in 1955 and 1958. Subcontractors are:

- Aerojet-General Nuclear Division—Four sodium reactor designs

- Raytheon Missile Systems—Fuel and materials

- Westinghouse Electric Corp.—All reactor designs

Research in handling the sodium demands including the pump, boiler, condenser, turbine and vapor condenser. A critical problem is that of heating liquid sodium to make gaseous sodium and then condensing it back to the liquid phase without exceeding the limits set by the physical properties of the materials used.

### Advanced System

The Spur system is supposed to be a generation more advanced than the Spur 5 sodium turbo-generator. The latest technology should give an unshielded Spur 5 weight-power ratio of 8 lb. per kilowatt and a shielded unit a ratio of 10 lb. per kilowatt. The present Spur 5 will weigh approximately 55 lb. per kilowatt. Radiator area for a 10-60 kw. Spur 5 has been set at 500 sq. ft. while only 700 sq. ft. of

tubular radiator surface is to be provided for the 180-hp. Spur.

Output of the Spur system is calculated to be at the stage needed to make ion motors or other electric rocket propulsion.

The first 300 kw., three-phase, 115-volt, 120-cps. system is supposed to operate unshielded for one year. The 1,800 kw. power version is to have a two or three year life. As well as being one-tenth the weight of systems designed with earlier Spur technology, Spur 5 size dimensions should be one-fourth those of the earlier units for a given power output. The sharp reduction in size and weight is made possible by lighter operating temperatures which cut radiator area and reduce shielding by making the reactor smaller. Spur 5 is designed for the turbine to be driven at 24,000 rpm. by a fluid at 1,600° while Spur 5 turbine is to be driven at sodium temperatures at 1,700°.

To operate at such high temperatures, Spur must use different alloy materials in

the two-phase energy transfer system. The first loop moves heat from the reactor to a heat exchanger where the energy is transferred to the fluid in the second loop. The fluid to be used in the first loop has not been announced but the fluid for the second loop will be sodium, potassium or cesium. After being vaporized at the heat exchanger, it will be expanded through the nozzle to strike the blades of the axial flow turbine. The initial design concept tests already performed indicate evaporation of boiling and condensation of the fluid metals under free-flow conditions and their compatibility with other materials in the system. There are highly reflective metals like tungsten, molybdenum and niobium alloys.

### Stage Dimensions

The Spur system is designed with the stages of the system strung out in a row inside the tubular body of the unit. The reactor is 16.3 in. long and the turbo-generator is 5 ft. long and weighs 370 lb. Diameter of the tube is 11.5 in. The turbine and generator are expected to achieve a combined efficiency of 79%.

The proposed sodium reactor to propel a Spur vehicle would develop 5 hp. at a specific impulse of 6,000 sec. The propellant tank would hold 2,500 lb. of cesium. Payload of the vehicle would be about 1,000 lb.

## PRODUCTION BRIEFING

Berth Air Line's new jet fleet of three DC-8s will be maintained by Lockheed Aircraft Service New York under terms of a contract between the Spanish company and the Lockheed firm. This makes the fourth contract awarded to L.A.S. in recent months for maintenance of American flag aircraft jets.

NASA's Marshall Space Flight Center has awarded two contracts totaling \$1,224,183 to International Business Machines Corp., Huntsville, Ala., for rental of electronic gear to compute astronomical and two-order data for the Saturn space vehicle project.

Galien Industries, Inc., of Metuchen, N. J., has received contracts totaling \$427,000 from Grumman Aircraft Engineering Corp., for primary power and power conversion systems for NASA's Orbiting Astronomical Observatory (OAO) program. Grumman is project executive and systems manager for OAO, which is expected to orbit at least six months and perform astronomical observations.

New Harker Saddle Industries, Ltd., division, Harker Saddle Engineering, has been formed to undertake design and construction of various pump



LOOP OF HASTELLOY X tube is subjected to a 3,000-psi forced liquid test with potassium hydride flowing at 30 ft. per minute in slurry to determine its ability to contain the alkali metal. The test structure is to be installed in a test and pre-assembly of a Boeing KC-130 for testing test tubes. Equipment on the test bench at 345 is instrumentation.

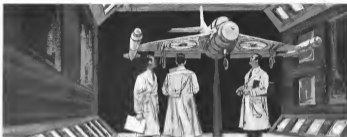
# This is systems capability at NAA-Columbus

Many of the significant advances in electro-mechanics, electronics systems, environment systems, and other areas, were originated and brought to fruition at the Columbus Division of North American Aviation. A complete center of advanced systems technology, the Columbus Division has the minds and facilities to convert original concepts into practical hardware with economy and efficiency. This is true systems capability... this is the Columbus Division.

## COLUMBUS DIVISION OF NORTH AMERICAN AVIATION



COLUMBUS, OHIO



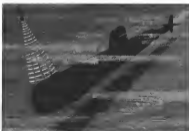
**WIND FACILITY:** NAA-Columbus has one of the largest wind tunnel systems design test facilities in the world (14 feet wide by 85 feet high). This is part of the extensive system facilities Columbus has used in the development of both lift-fan and tilt-wing aircraft which need no runway for take-off or landing.



**BOILER PLATE:** NAA-Columbus is building the complete Army Redhead-Roadrunner target missile system. This important new missile will fly accurately at supersonic velocities and will operate at altitudes up to 60,000 feet.



**"HAWTHORNE HILL" ANTENNA:** A 300-ft. antenna system, under a new concept that distributes tension evenly to avoid distortion in windage, is being built by Columbus for USAF on Hapgood Hill near Boston, Mass.



**ANTI-SUBMARINE WARFARE:** NAA-Columbus is at work on new applications of anti-submarine warfare to meet the threat of highly advanced submarines. Other research and development projects at Columbus include advanced battlefield surveillance, and surface-to-air and surface-to-surface missile systems.

acts, including radio telescopes and radio navigation systems.

**Collins Radio Co.** of Cedar Rapids, Iowa, will deliver airborne receivers for six Boeing B-52 bombers and KC-119 tankers under terms of an Air Force contract of more than \$1.5 million.

**Minneapolis-Honeywell**—Regulator Co.'s Boston Division has been awarded more than \$1 million in contracts by General Dynamics/Astronautics for rate gyroscopes to be used in Atlas SCIM guidance systems. Delivery will continue into early 1962.

**Kaman H-43D** Helicopter will be used as a flying electronics platform to simulate hostile launch conditions for test and calibration of guidance systems at Air Force Titan IIIC base. Kaman will install the equipment on one of the Helicopters at plant in Bloomfield, Conn.

The Garrett Corp.'s Allentown Manufacturing Division at Phoenix, Ariz., has received Navy contracts totaling \$762,000 for six turbine starters to be installed in F4V, W2F and A1D aircraft.

**Kale Bearing Corp.** of New York has been awarded contracts to supply bearings to aircraft manufacturers in West Germany and The Netherlands. The European companies will assemble and manufacture new bearings for components for the Lockheed F-104 NATO Basic fighter program.

**Arco** has awarded a \$474,325 contract to Philip Corp.'s Communications System Division for design, engineering and installation of a radio-wave, topography scatter communications system.

**Bentley Systems Division** at Ann Arbor, Mich., will design, build and test the prototype of a subsonic communications system for the Air Force Air Force Systems Command is developing the system for use in situations where normal facilities are not available.

**Goldfish Space Flight Center** has awarded a contract of approximately \$1 million to Minneapolis-Honeywell Regulator Co. for design and engineering services of a space environment facility to be constructed at Goddard, Md. The facility will check-out and test large spacecraft in two space chambers: 35 ft. in dia. and 32 ft. high. The chambers will be in operation by Oct. 31, 1962.

**Ryan Aeronautical Co.** has received a \$1,000,000 order covering 50 million lbs. production of air bearings for the KC-135 jet tanker and C-130 transport.

# Manned Orbital Assembly Program Urged

By Arthur Kestonovich

President Kennedy's commitment of the nation to a race for the first manned lunar landing requires a fresh approach. We must remember that it was recently in April of this year he was quoted as concluding that we must be "making the Moon the first thing to be second in this decade." This paper is intended to call attention to a technique whereby this country can, in two or three years, completely reverse the Russian advantage in booster thrust.

There are two techniques for achieving a large payload weight in space. The first is by increasing the size of the ground and developing a sufficiently large booster to put it into orbit. This technique, which has been almost neglected in our space program, could make it possible to launch payloads of considerable weight in space. This might have permitted despite the temporary technical boundary and instability of rendezvous, as brought out in a last series of engineering studies.<sup>1</sup> Yet present planning<sup>2</sup> calls for rendezvous rendezvous only after the Saturn booster is available. It is my belief that manned rendezvous in orbit with payloads available booster and no adaptation of the Marsian capsule.

The achievement of an orbital rendezvous capability will give America a tremendous advantage. It will allow us to achieve our production capabilities space orbital payloads and mission capabilities would depend on the number of boosters we could launch. It will not be limited by booster size. We should, therefore, make every effort to enter the manned assembly phase as soon as possible.

The answer to the critical question, "How quickly can this be done?" let us consider a simple plan designed to make maximum use of hardware available in 1963. Assume a rendezvous

Marsian capsule, weighing 3,000 lb and capable of orbiting a man. Add motor and optical component for maneuvering distance and velocity of co-orbiting satellites. Add life support component to permit flight up to two days. Add a small communications center for rendezvous maneuvers. Add an air lock, entry hatch to the orbit hatch. The Marsian capsule (RMC) will be better than the present Saturn chuffs because of the weight of the Marsian capsule. The vehicle's altitude required has been estimated in several studies.<sup>3</sup> Those that work, it can be concluded that a considerable rocket staging less than 10% of the vehicle weight will be required. Let us, therefore, assume that all these add-ons will cost to 100 lb so that RMC will weigh about 3,100 lb.

The reason for orbiting RMC needs to be at least 15,000 ft. This requirement suggests the use of modified, smaller boosters rather than new

larger boosters. We have presently available, in the Atlas-Agena B, a booster capable of putting 3,100 lb into a low orbit. This would allow enough margin to accomplish the above functions and to increase the safety factor of the RMC. It will also allow the margin required for adaptations to the Atlas-Agena B to launch the RMC. The time required to achieve rendezvous will depend on how accurately the launch vehicle can be maneuvered. Thus, launching within a 4-7 hr period allows rendezvous within one day.

For the orbiting of freight capsules we can use our more advanced boosters, which will not be required for the Marsian capsule to orbit a man. Thus, the Atlas and the Titan, when combined with upper stages such as the Centaur, can launch freight capsules up to 15,000 ft. When available, the Saturn can be used to launch even larger loads. When we achieve the rendezvous of a man with an unmanned life support capsule designed to allow him to survive the period of weeks we will have performed the critical step.<sup>4</sup> If we have a vehicle at that stage a capability to launch other men and other freight capsules at a rate of about one a week we can build up a permanent space station. This station should be established in a low-orbit orbit at an altitude of about 200 miles, this orbit chosen to avoid reentry problems.

When the permanent station has been built up to a point where the primary concern could be shifted from survival to an exploration for other purposes, we could then build up a capability to assemble vehicles in orbit. The manned station in fact, now requires a vehicle weighing between 100,000 and 200,000 lb. which, at 200,000 lb, would require 12 to 25 Atlas-Centaur launches. The permanent space station and the assembly and checkout equipment might not be the total weight in question up to say 1 million lb., requiring perhaps 100 or 125 Atlas-Centaur. Note that the cost of launching this group of vehicles is comparable to the development cost of Saturn.

Let us summarize the most important requirements to give an answer to the question, "How quickly can this be done?"

I modify Mission to RMC and

<sup>1</sup> Note that many are critical to rendezvous and

are concerned with developing and testing rendezvous vehicles.



**Aeronautics Expands Vacuum Test Facility**

Vacuum test chamber at Ford Motor Co's Aeronautics Division, Newport News, Va., was recently extended to 27 ft. in length and eight feet in height by the addition of the left die, low loss expansion. Facility now can contain objects up to 150 in. diameter has been used to test USAF F-4B Scout payloads and NASA lunar capsules.

edge it to an Atlas-Agena B launch vehicle.

2 Develop a life support capsule for Atlas (or Titan) Centaur launch vehicles.

3 Make available production and launch capabilities eight launching pads to launch about 100 Atlas (and upper stages) per year.

If these tasks are completed with the job that was done in achieving our initial RMC capability, it will be soon that the accomplishment of a permanent manned orbital station should take no longer than two to three years if we persevere with the agencies and contractors of the RMC program. Following the achievement of a permanent manned station, the assembly, the launching of the assembly gear and the man vehicle could be undertaken. The development and qualification of the man vehicle should certainly be begun immediately and again it does not appear that none of these requirements involve greater leaps in technology than those faced in the achievement of the RMC program.

## Space Laboratory

Another important use of such an assembly capability would be the construction of a permanent laboratory in space. Such a manned laboratory would permit the assembly of human-manufactured and various other terrestrial hardware—such as the construction of sophisticated satellites. But to our mind

its most important function would be as the nucleus of a laboratory where research of some disciplines could begin the existing process of launching their views to encompass the study men, whom we envision, tech inactivity will be forthcoming from men in space.

I believe that the achievement of a laboratory of this kind would further strengthen our hand against the speculative fear which the Russians do perceive. It would help to prevent, for example, the disastrous situation which could result if the Russians, by achieving a broader range of the possibilities of space, were the first to acquire truly new ideas.

## Production Capabilities

The great strength of American production capabilities has not been brought to bear on our space program. The achievement of rendezvous would give us a payload capability in space limited only by our production abilities. Thus, we need now only worry about the consequences of the Russian lead in the threat of individual boosters. Many of our production facilities are currently idle and the adaptation of some of these to the mass production of existing boosters is no more for suitable a program than the task we faced in the World War II production of military aircraft. Note that our present production capabilities for Atlas and Titan, if fully used and if paralleled

with adequate production of the carrier support stage, would allow us to put several million payloads a very short while. If needed, we could expand these production facilities at a rate the Russians could not match.

It has been almost unanimously agreed that manned rendezvous and assembly in space will eventually become a major phase of the space program. There are decided advantages to beginning this phase as early as possible. The question that should be put is, "Can we not rendezvous and assembly in space be begun with hardware available in 1963?"

## Martin Testing For Space Isolation Effect

Martin Co. tests indicate that a space vehicle astronaut may begin losing altitude after approximately 1 hr. of isolation.

Experiments, being performed in conjunction with National Aeronautics and Space Administration's Project Apollo, showed that light, vision, and hearing deteriorate after 1 hr. of isolation and fatigue factors—thus providing for adequate compensation.

Tests are conducted by having volunteers spend several hours isolated, separated from the world. Light, sound and electronic images are utilized to test the responses of the volunteers.



**Thermionic Converter**

Thermionic converter, which has produced 280 watts power with 19% efficiency, is now under test by Texas New Dallas Laboratories at Thompson Research. The converter is a thermionic space vehicle power system. TXW was in Texas Instruments has produced a 3-ft-dia. size solar concentrator by an electroforming process which has a cycle of oxidation of only 1 in. and with oxide reflectors of up to 95%.

1 All Proceedings of the March 1963 Space Technology Conference, sponsored by the Institute for Advanced Studies, within the Department of Industrial Engineering and Mechanical Engineering, and the School of Engineering, Los Angeles University, Los Angeles, California, April 1963.

2 By Douglas, John C. Problems and Possibilities of the International Space Station, in: Space Flight and Astronautics, the International Space Station, National Aeronautics and Space Administration, Washington, D.C., 1963.

3 Meeting held in the Conference on Space Technology, sponsored by the Institute for Advanced Studies, Los Angeles University, Los Angeles, California, April 1963.

4 Confirmed Rendezvous in Space.

## ONBOARD POWER — ENVIRONMENTAL CONTROL — FLIGHT CONTROL

#### HERBICIDE FLIGHT CONTROL



TAPCO

Therapeutic Goods Administration

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**CONTROLS EVALUATION** simulator is operated by project engineer R. M. Johnson, using video-area stick and foot-pedals to control roll, pitch and yaw gas reaction jets.

**Dallas, Tex.**—Automatic control evolution equipment, suspended upon a column of nitrogen gas pressurized at 130 psi, is being used by Gussow Vought Corp.'s Automatic Division to develop and test new systems designed for use in space.

The simulator is the first of three computer-aided devices planned for its "space on earth" testing capability—the others will be an environmental simulator for developing cameras, cold storage containers, and a communications console. In this condition the simulator is known as its jaw box, but if the test requires, a power source can be mounted aboard the frame and the simulator can be disconnected.

ACES can accommodate a pilot for manual control of the simulator or it can be controlled by a remote console. Manual control is afforded by display

cluding monitoring, navigation and re-entry problems.

ACFS, the abbreviation for Automatic Control Evaluation Simulator, is a 12-ft-long, 18-in.-x-Nova aluminum tubing enclosed platform, with a 4.5-in. diameter polished steel ball fixed to the bottom of the frame providing the air-bearing surface to afford a nearly frictionless connection to the column of nitrogen gas.



**Solar Concentrator Still**

Prototype solar concentrator built by Boeing team meets tests the critically of a thousand fold production version could reach about 100,000 sq ft. Concentrated beams of light are used to heat a fluid, which is then used to generate electricity.

mount of a side-arm control stick for pitch and roll and two pedals for yaw.

The shaker mounting is so well balanced that the most must be added to prevent drafts from upsetting its equilibrium or causing forces that must be countered to an unusual degree by the equipment under test. Clowse-Vought, a subsidiary of Low-Tempo-Vought, Inc., states that in addition to checking out products and control equipment planned for spacecraft use, the shaker will be useful in measuring the effects in a space vehicle of the forces of the reentry atmosphere, a solar cell array, hydraulic systems, such as dyes, or instruments and launchers of payload space vehicles. In conjunction with the air-borne platform the company has developed space nuclear reactor booth (AW 4/17 p. 13).

The simulator is being used initially on Clinton Mought space projects consisting of the development of a profitable and sustainable market basis for government agencies and industry. Among the first component evaluated by the company has been a new two-gene controller developed by the Electronics Division of the Defense Contracting Agency, Australia & Space Administration. Equipment has a growing necessity of providing a one-half arc-second. Future assignments include purely evaluation of the performance of the system, the broader optical system equipment for space use. Unleashing of innovations wheels to change space vehicle direction by varying speed of wheels, decrease accuracy, reduce, errors, false, and other factors, and other other future program envisaged.



### Solar Concentrator Studied for Space Power

Prototype solar concentrator built by Boeing Co. is a 5-ft.-dia. mirror array designed to focus energy onto the cathode of a thermionic converter. Prototype mirror weighs 10.1 lb. but production version might weigh only 5-6 lb. Mirror's reflecting surface is made of vacuum-deposited layers of silicon monoxide and aluminum.



Allstate Nami Sea I has sleek, smooth skin superior to many polished wood and fabric coverings. Wing trailing edge instead of dihedral is mechanically wayward to reduce possible tailwind drag caused by gap of conventionally split trailing edge flap. Pilot D. Ross, Scottsdale, Ariz., flew Sea during on last distance flight—about 100 mi—during 25th annual U.S. soaring championships at Wichita, Kan. (AW Aug. 21, p. 96). Sea sells for about \$6,800, but one finished to the standard of Ryan's world cost closer to \$10,000.



EP 15 Aa Mite (left), a design by former National Soaring Champion, Richard Schuler, has metal honeycomb bonded wing with Kevlar® plastic trailing edge. Koss KAA CR (right) owned by John Smith, Naperville, Ill., has German style tow wing hook on lower side of trailing, just ahead of single wheel. Before, sailplanes competing in 1965 annual U.S. soaring championships are positioned along runway at Wichita. V-tailed sailplane at left foreground is HP 8. An arrow operated on other side of airport during competition.



Koss KAA (left) typifies new foreign sailplanes, particularly German types, which are becoming very popular in the U.S. because of performance and low price (about \$1,000 basic). CR 30, sailplane competing at Wichita, was new KAA model and one built third place in total point scoring. Will equipped panel at right on K. E. Mason's Schweizer 120 typifies advanced soaring pilot's need for instrument trim and runway radio. These types of racemaster to increase vertical speed can diagonally in left under stopwatch. Schweizer's role building center instrument is evidenced as pilot can accurately gauge thermal strength as he can very speed to gain from one to another most effectively. Pilot musts control air energy, total energy viewpoint is unaffected by sailplane's speed.



## Sailplanes at Wichita Demonstrate Trend To Higher Performance



German LO-318, designed by the late Wolf Hirth, was piloted by A. J. Smith, Terrence, Mich., to first place in total points during meet, coming up from third place on last day of event by winning final event, at 60 mi. speed run to Salina, Kan., at 42.2 mph average.

# 17 reasons why you get highest reliability with G-E Five-Star tubes

In industrial and communication equipments—critical sockets where there can be no compromise with electronic tube performance—you can depend on the proven reliability of G-E Five-Star tubes. Let these 17 features of a typical Five-Star tube tell you why:

- 1 Seven design measures reduce—fewer points of possible failure—loss chance of short-circuiting particles from solid splices.
- 2 Positive cathode alloying assures reliability and long life in secondary spots normally where interface tends to develop.
- 3 Pins are assembled to prevent glass stress at socket connection.
- 4 Short, sturdy caps increase rigidity of tube structure.
- 5 Two wide spacers, with additional anti-leakage slots, deter internal pins, provide superior environmental resistance and require no vacuum adjustments. 12 or 28 contact pins—pin gap .0009 in. between ball end mount.
- 6 Highly efficient getter purifier throughout tube life and provides flash to avoid contamination leakage.
- 7 A pinless flash shield suppresses metal leakage characteristics.
- 8 G-locks strengthen through top and bottom when firmly secured the tube assembly.
- 9 Folded heater design proved most reliable under shock, vibration and heater system variations. Heater is temperature controlled to further improve reliability and lengthen life.
- 10 Complimentary coating of all heater leads after forming assures complete hermetic-cathode insulation.
- 11 Smooth grill legs prevent a "straw" action on the mesh, reducing grill vibration and microphone noise.
- 12 Coated grids are plated with gold or silver to insulate and measure.
- 13 Lead glass stems help ward off glass shattering.
- 14 Controlled mesh diameter on grids improves vibration and microphone.
- 15 Low thermal-conductivity cathode ink prevents thermal heat loss.
- 16 Cathode diameter and density of cathode coating is statistically controlled.
- 17 Plate pins are reinforced for added strength and improved wave fit.

G-E Five-Stars are not tubelike from standard receiving types. Their high reliability is a result of these special design features, special manufacturing processes, special tests, and stabilizing periods which may even exceed 100 hours of full-voltage operation. Order G-E Five-Star tubes from your General Electric tube distributor. He has them in stock. General Electric Company, Distributor Sales, Room 7153A, Greenboro, Kentucky.

Progress Is Our Most Important Product

**GENERAL ELECTRIC**



New rotorless rotor design by using under DME General-powered Augusta-Bell 204 which the Bellco Airco built at Milan under license to Bell. Two engines were carried in the cabin of the helicopter which has a maximum gross weight of 5,100 lb.

## Augusta-Bell 204 Shows Versatility

New Rotorless Airco, Features, with full control gear, shock absorber the 204 (below, left). At right the General-powered helicopter sling carries a jeep type vehicle. Demonstration was conducted at Rome's Uffizi airport for Italian government and military officials.





## What will the Surveyor find on the moon?

**Someday in 1963**, this spacecraft will land on the moon. In it will be over 200 pounds of scientific instruments designed to gather, analyze and transmit information about the moon's surface, subsurface and atmosphere.

The Hughes-designed Surveyor will be built to "soft land." As it approaches the moon, after a 66-hour flight from the earth, retro-rockets will be fired to control the impact of landing.

Then, working on three legs, the 750-pound moon explorer will set to work—in scenarios here on earth which via television. High-quality television pictures of the lunar landscape will be taken and transmitted. Drills will probe the moon's surface and samples will be brought up into the spacecraft for chemical analysis. Other instruments will measure the geophysical characteristics of the lunar surface, as well as the moon's magnetic and radiation fields.

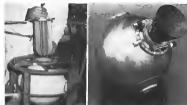
Hughes will build seven Surveyor vehicles which are scheduled to be launched at Cape Canaveral during the period 1963-65. The work is being performed for the National Aeronautics and Space Administration. Technical direction is by the California Institute of Technology Jet Propulsion Laboratory. The instruments which Surveyor gives us will be an important step toward the day when man himself will stand on the moon and look out over the universe.

Creating a new world with electronics

**HUGHES**

AN ELECTRONIC CORPORATION

## MISSILE ENGINEERING



### Titon II to Use Solid Propellant Vernier Engines

Two spherical solid propellant vernier motors, 15 in. in diameter and weighing about 88 lb each, will be used on the Titon II missile for final velocity adjustments and thrust vector control. The motors, developed by Thiokol's Motion M4, Division, use a polymethylene type propellant and are located beneath the skirt of the second stage. Thrust termination is achieved by blowing out the vernier tubes, thereby sealing them. Core (above, left) is inserted into the spherical casing while the propellant is still fluid.

### New Process Provides High-Pressure Cases

New York-Cryogenic stretching process, which gives tensile strengths of 200,000 psi and above with conventional stainless steel stock, has been developed by Aero-Fordland, Inc., Paterson, N. J. as a tool to provide lightweight, low-cost satellite pressure vessels and cases for the expanding field of solid propellant motors.

Aero uses the process with 15 to 30% less than conventional heat treated vessels, often much greater strength and ductility characteristics and that fewer steps—compared with 16 in a standard heat treat process—no rework in the fabrication of new gas case size.

Using AISI-304 (Austenitic Iron and Steel Institute grade) stainless steel, Aero has rolled 16 in. diameter spheres and 48 in. long, 12.5 in. dia. cylinders with typical wall thicknesses. These vessels, called pressure cases, were then placed in a cylindrical forming die and then both the end gas form filled with liquid nitrogen at -196°.

Cryogenic stretching was then forced into the pressure under high pressure and the vessel expanded to the limit of the die.

Aero has expanded the diameter of cylinders 11%—starting in the process a thickness of 250,000 psi and a wall thickness of 0.050 in. Yield point is above 250,000 psi.

The company, citing the advantages

of the process of forming are size reduction, lower case weight, higher material strength and lower production and tooling costs such as immediate market as for pressure vessels of the type used in about Apollo and Atlas-Star vehicles and future sales for solid propellant motor cases, both segmented and integral. For segmented cases, Aero says that joining flanges can be welded to the vessel after processing and the diameter of the case has been increased, and the case dies reinserted into the tank for cryogenic stress relieving. These vessels also maintain the compressive behavior it can produce is such up to 250,000 psi within one year.



**CRYOGENIC STRETCH-FORMING**, a metalworking technique developed by Aero-Fordland, Inc., expanded the case diameter at right about 11%, giving a tensile strength of 250,000 psi in the process. For lower case of the left was rolled at 187,000 psi.

PATCHBOARD

### PATCHCORD PINE

**CONTACT SPRINGS**

- Unique chevron design and 45° twist per cent amplified contact pressure and wiping action - 454000 longer life.
- Contact springs are self-aligning and are locked in rear board.
- Provide receptacles for taper pins to facilitate equipment wiring.

**IMP'S EXCLUSIVE  
DOUBLE WIPING ACTION:**

(D) All machine parts from inside of barrel and around each roller in a 360° wiper-wipe action.

(A) The wiper-wipe action is repeated 10 times per revolution of the barrel to provide a thorough cleaning action on every part of barrel.

(B) Depending on size of cylinder used a 100% barrel is used for barrel cleaning or constant wiping.

(A) Barrel action is in constant motion during all processing transfer—no stop or start.

**AMP INCORPORATED**  
GENERAL OFFICES: HARRISBURG, PENNSYLVANIA

## Airborne Thermoelectric Systems Studied

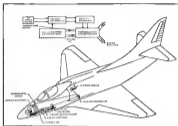
**El Segundo, Calif.**—Airborne power generation and cooling systems based on century-old concepts of thermoelectricity will be investigated by Douglas Aircraft Co. under a \$120,000 18-month Navy Bureau of Weapons contract.

In more recent years, research interest in thermochromism, stimulated largely by the availability of new and improved materials (chromostructures), has resulted in spot coating of various equipment and the construction of the "new" type of electrical cages to spare the animal from the heat of the sun and the cold of the winter. Nove has sponsored extensive thermochromic research primarily in materials, but also in experimental hardware associated therewith used in nuclear offshoots. Rudin Corp. of Astoria, Clatsop Co. and Whipple Inc. have worked with the Nove in developing thermochromic coating and reflective systems for underwater craft (JAW Mar. 2, 1960, p. 237).

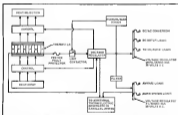
The use of thermoelectric devices as power in secondary power systems for aircraft as an aircraft component and cockpit cooling systems has been studied by other companies, before the current Navy Douglas program. At least one firm says it discontinued studies because of its estimates of prohibitively high costs of such systems.

One of the tests being Douglas will be to determine the weight, size, cost and engine power penalties that may have to be paid by using themselves the systems employing today's technology, and level of materials development as well as those that can be conceived by 2003.

Two phenomena used in thermoelectric devices are the Seebeck effect (discovered in 1821) and the Peltier effect (discovered in 1834). The Seebeck effect, for many years a valuable laboratory tool, is employed in thermocouples, devices that determine the temperature of an electric



**AIRBORNE** thermoelectric cooling system, one of several possible types to be studied by Douglas Aircraft Co. under a Navy-sponsored program, would employ d.c. voltage derived from conventional aircraft power source for Peltier (thermoelectric) cooling action.



**TYPICAL:** Piezoelectric power generation system to be employed in aircraft would have advantage of increased reliability because of absence of moving parts.

potential across a load by heating the junction between two dissimilar metals or semiconductors. The Peltier effect is the heating or cooling at a junction of two elements produced by current flow through them.

Dougherty will study applications of these phenomena to separate systems and a single combined power generation and cooling system. It will consider working waste exhaust heat to a thermoelectric generator consisting of

The present program will divide into two phases. They are:

• **Phase I—**Clustering of data and re-verification of thermoelectric power generation and cooling, an 18-month effort



## New Offerings

**Industrial Electronic Products Corp.**, New York, N. Y., manufactures of line component parts for electronic and electronic equipment including general and airborne communication equipment. Offering is \$1,000,000 of \$10 convertible subordinated debentures due 1976 and 175,000 common shares to the new holder. Of the proceeds \$210,000 will be used for expansion of the company's conversion bureau \$149,000 for buying up and production of solid state diodes. The balance is to be used for sales promotion, and advertising of the Pioneer Ltd. Inc. The company is attempting to become the exclusive U. S. distributor for British Ltd. aircraft tubes and test equipment tubes.

**Securities Inc.**, Bedford Mass., raises facilities of semiconductor. Offering is 175,000 Class A common shares at \$1 per share. Of the proceeds \$200,000 will be used for development of new products \$75,000 for expansion of manufacturing facilities \$10,000 for purchase in line of new equipment.

**Seaboard World Airlines, Inc.**, Jamaica N. Y., raises capital. Offering is 2,479,000 common shares to enable it to enlarge for the continuation of its standing subsidiaries. Securities may be sold from time to time on the American Stock Exchange as the securities market at prices then obtainable.

**Computer Instruments Corp.**, Thompson, N. Y., designs and manufactures of precision potentiometers, and related precision electronic components and measuring instruments. Offering is 100,



## New Diodes

Three new high temperature diodes, which can operate continuously at temperatures up to 500°C, are now available in single quantities from General Electric's Power Tube Dept., Schenectady, N. Y. The common diode with current ratings from 0.15 to 100 amp., have been successfully operated at 1,000 hrs. at 400°C GE says.

800 outstanding shares by the present holder.

**Yankee Electric Corp.**, New York, N. Y., engaged in development, design and manufacture of electronic components and subassembly interfaces and other related electronic components. Offering is 200,000 common shares. Of the proceeds \$1,250,000 will be used for additional equipment in the south expansion. The company's sales plan is \$100,000 to purchase equipment and equipment needed for the development of products that are products. \$200,000 can be used to pay the balance of the purchase price of the Stoughton projects. If the company decides not to exercise its option to sell and lease back the project.

**Proctor Air Industries, Inc.**, Chicago Ill. (former), Proctor Tool and Engineering Co.) develops and produces electronic mechanical components and is involved in purchase, retention and other reorganization of assets and stock holdings. Offering is 150,000 common shares. Of the proceeds \$1,000,000 will be used in connection with the proposed reorganization and operation of a plant in California and the balance for additional equipment and working capital in the Chicago plant.

**Canon Electronics, Inc.**, Boston, Mass., distributes of electronic components and equipment in the New England area. Offering is 100,000 common shares, 187,750 for public sale by the company, and 42,750 outstanding shares by the present holder. Of the proceeds of the company sale \$445,000 will be used to acquire back stock. The company plans to use \$100,000 of the proceeds in its division, and a similar amount will be loaned to its subsidiaries.



**Zip Aero, El Segundo, Calif.**, engaged in aircraft engineering, development and manufacture of aircraft systems and accessories used in aircraft assembly, jet transport and other aircraft manufacturing. Offering is 50,000 common shares, 18,000 for public sale by the company, and 32,000 in William J. Zip, founder, president and board chairman. Proceeds will be used to increase inventory (\$100,000) and for plant expansion and acquisition of additional production equipment for facilities in El Segundo and Denver (\$120,000).

**Electro-Vac Corp.**, South Hackensack, N. J., engaged in the design, development and manufacture of air ring

and bank lock assemblies, switching devices and valves for electronic equipment. Offering is 91,000 outstanding common shares.

**Magnetic Metals Co.**, Cranston N. J., engaged in the development and manufacture of magnetic components which serve base units in the electrical and electronic equipment. Offering is 157,130 outstanding common shares.

**American Mass Drivers, Inc.**, Princeton, N.J., engaged in Mass. 1965, company proposes to engage in the sale, electronic equipment including, including research, development, design and manufacture of electronic devices and components. Offering is 1,000,000 Class A common shares at \$1.15 per share. Of the proceeds \$250,000 will be used for the purchase of capital equipment needed in a proposed plant. \$1,000,000 for materials for production and six others \$250,000 for expenses of operating the plant.

**Marshall Industries, San Marino, Calif.**, engaged in research, development, design and manufacture of electronic components and subassemblies for use in space and missile applications. Offering is 101,195 common shares to expansion facilities at the site of one new share for each four shares held. The company plans to use \$100,000 of the proceeds in its division, and a similar amount will be loaned to its subsidiaries.

**Cooring Glass Works, Coating, N. Y., manufacturer of glass products having special qualities of chemical stability, electrical resistance, heat resistance, light transmission and surface strength. Offering is 150,000 common shares by the present holder.**



## Loran-C Receiver

Transmitted Loran-C receiver for precision navigation is now available in commercial model (right) under the ANSP-7000 has been produced for the Coast Guard. Unit is in a cabinet for flying Loran-C signals and serves as a test equipment for the manufacturer. Collins Radio Co., Box 1975, Dallas, Tex.

## WHO'S WHERE

(Continued from page 23)

## Changes

**Don E. Treadwell**, manager marketing, General Electric Co., Tampa, assistant, Southwestern Bell, involved **Kenneth E. Finkler**, who assumes marketing responsibility for the Industrial and Control Systems Division of GE's Defense Services Division, Boston, N. Y.

**Robert W. Kluge**, director special duty research, The Martin Co.'s (Florida) Division, St. Petersburg, director of special systems **Blanton K. Steele**, director marketing, Lockheed Aircraft Corp., Los Angeles.

**W. Lewis Whitely**, deputy general manager, Aircraft Division, Hughes Aircraft Co., Los Angeles, Calif. Other appointments: **Harold E. Shewhart**, controller, **James W. Ross**, assistant general manager, **John J. O'Connell**, director and general manager sales manager **James B. Edwards**, director mechanical systems, **James S. Farn**, director engineering, **James A. V. Duffin**, director sales and assistant to the vice president general manager for space, **Lee J. Decker**, director engineering and product development, **Charles R. Shoop**, deputy director and chief engineer (aircraft) aircraft construction.

**Arthur P. H.E.**, formerly assistant to the president of Mite Corp., named director of Florida advanced research in the new Boeing Test, Mass. facility.

**Reginald S. Behring**, manager of the Washington, D.C. Regional Office for Laboratories for Electronics, Inc.

**Frederic V. Green**, first coast regional director of facilities, marketing, American Bosch Air Corp., Garden City, N. Y.

**Paul J. Green**, first coast regional director of facilities, marketing, American Bosch Air Corp., Garden City, N. Y.

**Stephen H. Smith**, first coast regional director of facilities, marketing, American Bosch Air Corp., Garden City, N. Y.

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DC-4B and for experimental craft  
De-Icers near the leading edge of the  
Pneumatic De-Icers are used.



"WAIL-SAFE" DE-ICING is provided  
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LIGHTWEIGHT  
PNEUMATIC

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HEATED RUBBER

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aerospace and defense products

## MANAGEMENT

# Farnborough to Remain All-British Show

By Herbert J. Collins

London-Berlin's aviation industry, despite all concerted effort to revive deeper into the international aerospace market, will keep its traditional close-knit annual Farnborough Air Show—a purely British effort for the foreseeable future.

But the trend toward deeper penetration of the aerospace market, at worldwide exhibitions and tentacles in the space field at the moment, may change that view, especially in the near future, when Britain joins other European nations in a joint space program.

Richard Bennett, chief executive and director of the Society of British Aircraft Constructors, the Farnborough sponsor, says his organization is so closely tied to a particular country as to display British and most other national companies which would come from foreign countries.

### Space Program Factor

But there is a new theme in the drive and it is a direct result of the approach to space now being. Bennett said the SBAC will conduct a "thematic inquiry" among its members and this will be aimed at determining whether Farnborough will become international or

of an into a limited international show.

The definition of limited includes limited the view that the SBAC, not family attend Generalissimo's country, such as Canada and Australia, into the show. Another factor is that Britain is gradually moving toward participation in the European Common Market in full partner.

It's all far from settled—still early in the conventional stage—but it affects the criteria to past criteria that the Farnborough show can provide, little evidence view in a single 12-month horizon.

Bennett himself does not agree with this. But he "has a poor level of show where you only display one type and model. Or you have one type and model that has appeared in the past, but they are improved versions and the improvements themselves are of no interest."

Bennett, however, continued, Farnborough in the past few years has taken an international stage deeper, still. The focus has been to attract foreign businessmen in British companies, primarily through U.S. financing and loans, but in the production of foreign goods under license. At the same time, the British aviation industry has ex-

panded its license agreements with manufacturers in various foreign nations.

All this, however, might be evidence that the demand for Farnborough since the war is greater than ever before. More exhibition buildings has had to be enlarged and the expansion park is 25% larger than last year. There will be about 40 stands when the show opens Sept. 4.

### Heavy Plans Missing

Still, the air will be dominated by the Royal Air Force and the air plan which remains would date in some extent will be far from the show. For instance, the Royal T155 stealthy steel March 2 research plane has left out and has not yet been shown.

The British Aircraft Corp.'s TSR2, the first strike fighter in the air at King's College and Vickers-Armstrongs and probably won't be shown even in model form.

Thames Valley's new P1127 VTOL fighter is deeply involved in the program, but program and not yet complete at all. The Hawker Pigeon delta aircraft plane has just made its first flight.

In the transport field, the de Havilland Trident recently rolled out and

won't be until winter. The Vickers VC10 and BAC 111 are on the production line, as is the Short SC7 Beluga for long-range transport. The de Havilland Jet Dragon, a new executive transport will be shown in model form. The company is still under construction at Hatfield. An Avro 660, the version for RAF, will be shown.

That leaves the new plane field to Beagle, the Bristol Steel Co., Ltd.'s business aviation unit, which has traced the making of its new Beagle 180 light twin for the Farnborough show, and it is given, based on single-engine Avro 146 for the Southampton display at Coventry last April.

### Blue Steel

The missile field will be dominated by Blue Steel, prime power in the forthcoming British space effort. The recent missile, Red Top, a follow-on to Trident, probably won't be shown because of security restrictions. The other major weapons—Bloodhound, Vigilant, Sea Stag and Blue Water—have been shown before, in model and live form.

Of primary interest in the new engine field will be the Rolls-Royce and Bristol Siddeley, revised jet engines which promise to be the most powerful jet engines built. Rolls will show its RC402 Common engine for the first time.

A feature of this year's display, Bennett said, is the visual presentation of the results of progress Britain's aircraft industry. An informal agreement will not be completed. He said it is an excellent collection of "living in the day of the big wars" and adds:

"Comparing has been a very important factor, and makes with exceptional usefulness, despite considerable differences and Bennett intends to assist when the calculations are first proposed to the industry by the then Minister of Aviation, Duncan Sandys. On the other hand, Bennett should keep its own eyes open."

The aerospace transport, he continued, is the logical development toward better, cheaper, faster and more sophisticated, and like the jet transport, brings with it tremendous losses, such as the new Boeing 747.

In addition, the question of financing is prominent and Bennett believes Britain can build the aerospace transport only with extensive government aid.

The trend toward this has already started, with talks under way between the Royal Aircraft Establishment, Foreign Ministry of Transport, Air Aviation and British Aircraft Corp. in the possible acquisition. (AW July 24, P. 21)

Tending to a less striking, but important, field of civilian-business flying—Bennett doubts that Britain still can ever be a big market because of its



### Army Orders Firebee Missile Targets

Ryan Industries has been awarded a contract to supply a model of a Firebee missile, a version of the Q1C Arrow. Ryan Aircraft Corp. is delivering the Q1C to White Sands Missile Range, N. M., for use in Army surface-to-air missile launching training. Army launches Firebee from a cross-height launcher.

doxy in a health state, with a high complement and export factor, but there is a need for aggressive sales to keep it healthy.

"The Russians have it made," he said. "They just tell their people what they want and they get it. As a consequence, of course, can't do that. But the Americans are not willing to do that for their country and its products and we are in a state of flux."

### Soviet Transport

Of equal importance is the necessity to keep British research and development at a high pace, particularly since the aviation industry's exports are a small part in the nation's overall economy.

And this includes the race toward the aerospace transport, in Bennett's opinion.

Bennett continued the program toward forward, although he believes toward caution "because we cannot be allowed to allow developments in the aerospace field."

The aerospace transport, he continued, is the logical development toward better, cheaper, faster and more sophisticated, and like the jet transport, brings with it tremendous losses, such as the new Boeing 747.

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two major conflicts—weather and congested airports. But the British effort is growing, in spite of present restrictions on a government level, and should be a force to reckon with in a few years, Bennett continued, in the export field if not home at least.

The exports, however, sharply by the arms export restrictions. In the first six months of this year, just \$15 million over that period a year ago. Of the total, exports brought in just \$12.5 million. The industry exports 225,480 persons, or 14,100 more than in May, 1960.

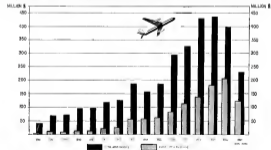
### Military Maintenance Contracts "Reasonable"

Washington-Trenton by representatives of the State military arm has advised members of the House Armed Services Investigating Subcommittee that a reasonable balance is being maintained between military and civilian operations and maintenance work.

Joseph S. Scarce, assistant secretary of Air Force for military, said the subcommittee and staff cannot perform "all civilian and direct contract support functions with income capability" and contract not for reduced combat functions which will result in improved effectiveness or greater economy. He said that due to a shortage of skilled personnel, USAF has contracted out "more than we would have patterned, particularly in the electronics field," but is now in the process of converting the situation.

As an example, Scarce said that USAF is now saving SACRE power plants and computers and the Alouette segment of DEW Line with its own personnel.

Kenneth S. De Luca, assistant sec-



IMPORTANCE of aerospace exports to the British aircraft industry's export market is illustrated in this chart prepared by the Society of British Aircraft Constructors. First year of 1955 was due to heavy sales of Vickers Viscounts, Hawker Hunters and English Electric Canberras. The Hunter, for instance, was sold to 11 air forces for about \$14 million.



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tion of Navy for installations and logistics, and Navy's policy is to keep "a representative capability in-house for nearly every type of maintenance necessary to keep in readiness its ships, aircraft, and associated weapons." Navy will continue to contract out for maintenance work on major components that involve test facilities available at contractor plants and for work with commercial counterparts which can be more cheaply conducted in contractor plants, DeLam told.

Maj Gen William B. Beaker, commander of Army's Transportation Medical Command, reported that the "major portion" of Army aircraft, engine and component maintenance has been and will continue to be performed on a contract basis, but that Army is purchasing an installation at Corpus Christi, Tex., which will be "capable of overhaul and repair of the full range but not the full quantity of non-mission-critical aircraft interest." Re-habilitation of the Corpus Christi installation, built by Navy at a cost of \$75 million, started in July. It will cost an estimated \$700,000.

Beaker reported that in Fiscal 1961, Army spent \$4 million on in-house maintenance of its aircraft equipment compared with \$20.7 million in contractor maintenance.

Issues reported these payments for contractor operator USAF facilities in Fiscal 1961:

- Pan American World Airways, Atlanta: Missile Range, Florida, \$45.5 million
- AEC, the Arnold Engineering Development Center, Tullahoma, Tenn., \$71.1 million
- Vesco Corp. of America, Eglin Air Force Base, Florida, \$76 million
- Calspan Engineering Co., Edwards Air Force Base, \$17 million
- Tingstad Co., Tucson, \$4.4 million
- Vinsell Corp., San Antonio, \$4.4 million
- Federal Electric Corp., DEW Line, \$4.3 million
- Rohm Corp. of America, White Alice communications system, Alaska, \$61.4 million
- Kaiser Corp. of America, SAGEWS \$47 million
- Royal Canadian Air Force, Pine Tree site, \$5.7 million.

Issues also reported these payments for contractor operator of USAF air defense systems:

- Vinsell Corp., \$1.1 million
- Vesco Corp. of America, \$5.4 million
- M & T Co., \$750,000
- American Hydrotherm Corp., \$612,000
- RCA Service Co., \$1.2 million
- Sexton Development Corp., \$307 million
- Western Electric Co., \$19.4 million

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Highly reliable, with a long shelf life, this new timer represents a remarkable design breakthrough. For further information write Honeywell Military Products Group, 600 Second St. N., Hopkins, Minn.

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U. S. AIR FORCE North American F-100 (foreground), McDonnell F-4 Phantom II (background) and Republic F-4B on the maintenance and modification line at Chateaufort is a facility managed and staffed by SERIMA, an indirect subsidiary of Sud Aviation. SERIMA is one of a number of European firms maintaining USAF aircraft and engine under contract.

## Europeans to Keep USAF Overhaul Work

By Cecil Brownlee

Chateaufort—Federal gold flow decisions will have little impact upon U.S. Air Force maintenance and modification contracts in Western Europe because of the substantial transfers in time, money and technical talent an engine service work flow to North America would entail.

At the moment, approximately 95% of the maintenance of all USAF aircraft operationally assigned to that theater is carried out by European firms, and the percentage now stands at 100% before the end of the current fiscal year. Turboprop maintenance programs probably also will be retained in Europe.

### Cost Differences

Some preference work, however, is being directed back to the U.S. since the cost difference falls within the framework of the new federal gold flow decision stipulating that projects that can be handled in the U.S. at an additional price of not more than 25% should be returned there whenever possible, unless firm contractual commitments flow out of the decision or which touch upon a number of areas, in which the general rule that has been breaking down from the U.S. and into foreign markets at a rate that has been slowing recently.

Otherwise, if the aircraft engines, work can be contracted here for parts saving from almost one-half to approximately one-half the cost of what it would be in the U.S. In terms of total cost per direct labor hour and indirect

air maintenance of the services, less work shifts would entail, a factor that becomes more vital as tensions are mounting the Berlin crisis scenario.

At present, these maintenance and modification programs within Europe, coupled with those of American-owned, Marshall Air contractors in the area, are big business for the best involved, totaling about \$41 million in fiscal 1961, and consume a large share of the time and effort of the Air Materiel Photo, European Area (AMTEPA), which maintains for the projects and their staffs in their general management aspects.

AMTEPA, headquartered here and commanded by Maj. Gen. George E. Pace, is an organization of many facets including such capabilities as rapid response logistic support to the United Nations' military effort in the

Republic of Congo, and it acts both as an extension of the Pentagon headquarters of the Air Force Logistics Command and, as a member of projects, as a conceptual attitude Air Materiel Area that while its responsibilities are the same, modification and maintenance is where the money is," according to Gen. Pace.

### Services Cited

Strong though contracting maintenance and modification work of European-based aircraft within the theater is opposed to returning them to the U.S. for identical reasons can be, in fact, partly restricted when you think in terms of direct labor cost and "manpower."

In the U.S. an Air Force unit of about an outstanding cost of a direct labor hour in \$6.00, Gen. Pace says,



SPAIN'S Contruction Asociacion S. A. (CASA) is one of the Air Force's major European contractors. In picture above, Air Force pilots are testing out F-100 for acceptance flight after maintenance and modification by CASA technicians. Aircraft should have been checked by Spanish company pilots. Average number of defects found by CASA pilots on CASA modified F-100s has been 1.7 per aircraft since the program began over a year ago. There has been a "safety of flight defect."

"It's a miracle if you can ever get under it." This compares with AMTEPA figures that rate a single working hour at a low of \$1.15 in Spain to a high of \$1.96 in England. Other countries include Portugal, \$2.25; Italy, \$1.75; and France, \$2.55.

In some countries—Spain is a notable example—work can be contracted and paid for with its own dollars, cutting up, in fact, funds that otherwise might never be used.

Using Spain as the example, the U.S. builds up large blocks of permits their assets—at a present rate of \$16 and less since a very thin if any spend-in program for technical aid and sale of surplus commodities. These funds can be returned from Spain, but can be, and are, put to use advantage in paying for such programs as AMTEPA maintenance and modification contracts with Spanish firms.

### Anti-Gold Flow

In another anti-gold flow move, AMTEPA is now negotiating with the Italian government to pay for road time there with surplus agricultural commodities rather than with hard cash.

In talking out of work here is compared with that in the U.S., Gen. Pace remarks that "these big spenders are talking about not so much gold, and we're talking in terms of direct labor hours. We're not talking about the cost of the materials consumed. It costs something to ship them over here, but this is very small when compared with the cost of labor."

"To a reasonable degree," he adds, the companies also can be applied to the company, "but if you get to competing companies, there's a tough to decide what to go."

Generally, the added cost of doing the work within the U.S. does not exceed the gold flow diversion limits here, "manpower" too, have enough capacity to allow you to stay by and instead of the Pratt & Whitney F4U already has been shifted from Europe to the U.S. Cost of other programs as well as work presently being contracted in Europe in order evaluation and also could be transferred.

Partial savings on engine modification are evident from an example cited by Col. George Rostwick, AMTEPA deputy director and a triple ace of World War II.

Here, AMTEPA returned a director from the major Air Materiel Area soon named to the U.S. suggesting that it moved up its long C-47 transports that had been on loan to The Netherlands and were now being returned. The director said a total of \$133,000 had been set aside for AMTEPA to arrange for the transfer, support the aircraft and have them fitted for long flights



FRENCH WORKMEN inspect the wiring of an F-100 at SERIMA's Chateaufort facility.

back to the U.S., including the installation of additional fuel tanks. The C-47s were then to undergo engine overhaul and refurbishing before being transferred once again to serving French squadrons, some of them located in Africa.

One gas here," Rostwick says, "has pointed that we do the rehabilitation work over here. It would save money and eliminate the need of establishing fuel tanks on aircraft that were going to end up in Africa."

The prime ASMA accepted five and the planes are now being scheduled for just a few thousand dollars more than \$112,000. This one also is going to save about \$70,000," Gen. Rostwick said.

European contractors for the overhaul work in Orleans, France, the Air Materiel Association (OCMA) Protop's contract of the Air Force Logistics Command. OCMA also handles, under contract, most of the maintenance and overhaul of C-47 and C-54 transports based in Europe.

So far as the quality of work, by

European contractors is concerned, Gen. Pace says, "there's no limit to what they can do on major overhaul and modification over here. The work, working and more needed to do the job compares favorably with that in the U.S."

### Spain's Record

As an example, he cites the record of Spain's Contruction Asociacion S. A. (CASA) whose Getafe plant outside Madrid has been modifying and maintaining North American F-100 fighter-bombers at a rate of better than 40 aircraft per month for more than a year now.

Once off of the line, the planes are first checked out by a CASA pilot and then by a USAF acceptance pilot. An average number of defects on the acceptance phase based on the Air Force pilots has been 1.5 per aircraft, and, since the program began, none of these has been a "safety of flight defect."

A similar record has been established by CASA's San Luis plant which has an IRAN contract for the Lockheed F-75

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95 percent of the time. Average number of "softs of flight defects" in this program has been 101 per month.

European contractors working for AMTEA who do not have company pilots to check the aircraft before they are turned over to USAF have accumulated an average of 3.0 defects per flight. But this "safety of flight defects" is all paid out way now they do it.

The general's scope of responsibility, and the area in which he can contract, range wide, taking in Western Europe and Africa in one sweep and then extending eastward to the border between East Pakistan and Burma. At the Burma border, AMTEA's contract comes to an end. At Mutual Peace, Middle East, they end on a border extending on to a point east of China.

#### Expensive Choice

In the maintenance and modification field, Gen. Price says he has seen how this expensive western rule to choose from in the selection of contractors, with their decisions hanging upon a variety of factors—cost, capability, availability, political expediency—goes to 11 S. policy, gold and power, to the operational needs of the aircraft in question, to make a few dollars about this aspect of his job, Gen. Price says.

"All other things being equal, you

normally would give it to the low bidder but you have to inspect other things on there, and then it's not necessarily equal."

That problem, just as an example, you might not consider it advisable to put all your technical into one country where there might be a sudden deviation of the economy, prolonged strikes, a change of government—just name it.

"You also have to figure in the time portions costs and the start-up costs. If, for instance, you have a man with a going facility who's done work for us and another man bids against him, the second man is at roughly a \$100,000 disadvantage." That is what it would cost him to start in business to modify his facilities for Air Force programs.

"You also have to take the man's technical and management capabilities into consideration," Gen. Price continued.

"And, the gold flow plays a part. For instance, if someone someone embedded Spain—say he had \$100 and Spain had \$117—now might split it 50-50 since we have them blocked pretty down there, and working in Spain doesn't cost you anything on the gold flow."

That also, of course, are the primary military needs of diversification of effort and the large political require-

ment of sharing the wealth with as many allied countries as possible. France, as an example of the latter, is best as one of AMTEA headquarters will, as such, expects and expects a concrete sense close of the outline.

As a practical matter, however, based upon the extent of technological knowledge and primarily, AMTEA's contract are governed primarily in Western Europe, with a few others lightly touching the borders of North Africa and the Middle East.

Dr. Carl E. Maher's Directorate of Procurement and Production within AMTEA is currently administering approximately 90 contracts. These include "primary" contracts, those let in the field, plus approximately 10 "secondary" contracts, those portions of wide-range USAF projects which fall within the area of responsibility. Examples of the latter include support of non-AMTEA communication equipment, the help to enable early warning system, the tropospheric scatter project and support of missile systems including the Thor-les Thor ICBM and the Nike Zeus and Minuteman test sets.

#### Secondary Contracts

Although small in number, the European portion of the secondary contracts comprises by its nature a substantially larger sum of money—\$190 million at present—when compared with the \$41 million for the primary awards, \$25 million of which is going into a single project, the F-105. One exception is the Mutual Aid contract of Turkey and Greece.

Aide from its F-105 and T-38 program contracts, Spain's CASA also has a facility in Cuba performing ICBM maintenance on USAF Atlas B-19 interceptors, while CASA's Gales is maintaining North American T-28s have been for use by a Mutual Aid contract to the AMTEA fleet.

Another Spanish firm, Accionero Industrial S.A., is performing a portion of the work now under way for Canada, taken off the books on Genov's F-102 interceptors for use with a better emergency landing system now being adapted. Work by Portugal's OCA, includes the rearming of G-14 fuel tanks.

In France, AMTEA is currently maintaining a number of contractors, the only one on Chateaufort, Decol, whose portion of the growing USAF inventory loss. Here, S.E.R.I.M.A. is an oldest and oldest subsidiary of Sud Aviation, is conducting close airforce and fire control-system maintenance on USAF McDonnell F-3H interceptors and reconnaissance aircraft and Air Force maintenance, on the F-101. Although not one of AMTEA's primary, S.E.R.I.M.A. is maintaining a number of French Air Force F-100s. The Republic F-105's latest

## Control and Instrumentation Engineers

A key research and development program is now underway at Atomic International to design long-life, compact, lightweight nuclear reactors that will provide auxiliary power systems for space applications. Many interesting problems exist to challenge electrical engineers who want to relate their present experience to reactor technology in any of the following areas:

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#### TELEMETRY

Responsible engineers to analyze, plan and specify the telemetry required to ascertain the performance of nuclear power plants during space tests. The individuals must have experience in analog instrumentation and telemetry of temperature, vibration, acceleration, etc. BS or MS preferred.

#### CONTROL ANALYSIS

Dynamic and control analysis including system start-up and full power operation. BS or MS preferred with familiarity with latest analog and digital techniques required.

#### CIRCUIT DESIGN

Electronics engineers experienced with both vacuum tube and magnetic devices to design and develop control circuits for compact nuclear power plants.

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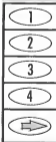
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entry into the European theater, also may be covered here as it phases into operational service.

Rada Corp. of America, acting through a French subcontractor a subsidiary, Radae under French law, is working here on the modification and repair of electronic test equipment on a contract basis. Another U.S. firm, Transpac Co. Inc., which also is working with a French subcontractor has responsibility for repair of Air Force vehicles and aircraft ground support equipment.

## Sud Facility

In other areas, Sud-Aviation Inc. is a growing engineering Republic F-34 fighter bombers that have been phased out of the Air Force inventory but still will be used by United Arab Emirates while SNECMA has a contract for the overhaul of the 17,500-lb. thrust Pratt & Whitney JT3 turbojet engines used by the F-4E and Transpac Service Intervention (T.S.I.) under a performing term contract for maintenance for Military Air Transport Service aircraft. Other AMFCA contracts, on a contract basis, include:

- **Belgium**—Adrian Belgium World Airline maintenance and periodic inspection of various USAF cargo aircraft including the Lockheed C-130 transport; Buhlmann/Dresser Engineering Co. vehicle repair.
- **United Kingdom**—Number of aircraft contracts in the area of engine overhaul, engine and propeller repair. Field Aircraft Service Ltd., specialists and aircraft damage repair on the McDonnell F-101 British Oxygen Company contract for the supply of oxygen. British Oxygen America Corp. overhaul of the Wright R3350 gas turbine engine.

- **West Germany**—Number of aircraft contracts, Airplane, portion of the F-302 tail boom, engine program. Luft Kiewit, a U.S.-owned subsidiary, for control system components. Kiewit-Gardiner, supply of liquid and hydraulic oxygen.

- **Italy**—F-4C production of G. 91, for United Arab Emirates. See Markets available of General C-130 transport and maintenance of Republic C-130 transport for United Arab Emirates.

- **Spain**—Several contracts to assist and on-site plants to look up for the service of American support system supplied to Spain and other allied countries in the Middle East. Spanish communications control administration and operation of communication facilities for all U.S. forces in Spain.

- **North Africa**—Major, United Arab Airline maintenance maintenance of Military Air Transport Service aircraft in Com. report. Casablanca area, several contracts for pipeline maintenance.



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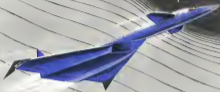
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# "FORGING MILITARY SPACEPOWER"

## USAF SYSTEMS COMMAND ISSUE

SEPTEMBER 25, 1961



On September 25, AVIATION WEEK and Space Technology will publish one of the most important issues in its history . . . "FORGING MILITARY SPACEPOWER" — USAF SYSTEMS COMMAND ISSUE. For the first time, the complete story of the newly activated USAF Systems Command will be presented to the aerospace industry throughout the world.

The new Systems Command will serve as a single agency to control R&D and procurement of all aircraft, missile, aviation and space systems for the USAF from the idea stage through the time they are in the field ready for use. This concept of a single agency for both systems R&D and systems procurement will have penetrating impact on all aerospace industry companies selling hardware or

research services to the Air Force.

The Systems Command will control approximately \$15 billion in contracts and annually will award \$7-8 billion in new contracts making it the most important single source of aerospace industry business. Further evidence of the impact on industry are policy and procedure changes which can be expected in many areas such as technical approach, contract competition, proposals, cost estimating, management structure and subcontracting.

These are just a few of the important details to be covered in the Systems Command issue, which will constitute a new handbook in doing business with the Air Force. Teams of AVIATION WEEK editors are now visiting the various bases of the Command for full, complete reports. Detailed edi-

torial coverage will be given to procurement, organization, plans and programs, policies, procedures and future technical activities.

AVIATION WEEK is privileged to present this edition to the industry covering our newest and vitally important Command. Prime contractors, subcontractors, suppliers and firms doing R&D work for the Air Force will be extremely interested in this new issue which will lay the groundwork for future contacts with the Command. It will supersede all previous editions on USAF research, development and procurement policies.

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A 150-foot antenna at the antenna being designed for NATO space technology center and opportunity.

## New research and development opportunities for Engineers

Currently undergoing static and dynamic tests at NAA-Columbus is a 1/16 scale model of the 150-foot antenna system which will be located on "Haystack Hill" near Plymouth, Massachusetts. It is the purpose of this model to verify the behavior of the static deflection under inertial loads as well as to determine the antenna's vibration characteristics.

This antenna model is typical of the efforts expended at NAA-Columbus to ensure that static and dynamic structural deflections of such systems are kept to an absolute minimum to ensure the greatest possible system accuracy.

Engineers with advanced degrees interested in Research and Development desirous of the problems of deflection characteristics of such large ground based systems under static (inertial), dynamic (vibrational, wind), and thermal loads are required immediately.

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and operation and for port handling facilities.

Don said Luxembourg comes in for its share with a contract for the modification of its tanks to thereby acquire armor. Contracts in the Middle East, however, are primarily for emergency maintenance of transport assets.

Of the sponsored USAF contracts now in Europe, all but those of a small Douglas B-57 and a Boeing K-100 tanker group are currently being institutionalized within the theater. These two, represented in too small numbers to make a European operation economical, remain to the U. S. for maintenance as do the contract F-106 Lockheed F-104 and MACTS operations which remain in Europe for only brief periods at a time.

In almost support of other functions, Col. Maher's office currently has a number of new aspects set for bids in companies in several countries. When a contract is to be let, rather than blanket advertising, Maher's office asks a selected number of companies to submit bids taking in the usual requirements of capability, present work load, location etc.

### Facility Requirements

Prior to Fiscal 1961, most contracts were on a time and material basis. As its familiarity with its customers grows, however, AMFEA hopes to turn some and more to straight fee-price contracts and a resultant savings in cost.

To monitor these contracts, Maher's headquarters has field or procurement offices in Wiesbaden, Bonn, London, Luxembourg and Madrid plus a small operation in Tunis, Italy.

The Madrid office, as an example, has between 60 and 70 people spread out among the various contract work with each specializing in quality control, flight test, combat administration and repair.

Their reports flow back into the Madrid office and, from there, are consolidated from to Maher so that a current status report on work and progress is always available.

Another AMFEA function is that of an aircraft evaluator for the Logistic Command and the individual Air Material Areas.

For instance, as F-104 of the national and in Spain is discarded, normal responsibility for arranging for its repair would be with the aircraft's prime AM, in this case Spaniards.

But in Gen. Pace explains, "Spaniards couldn't know what to do with one."

"So we take it, at the place, arrange the cost of repair and tell Spaniards, 'Send us the money, and we'll get it fixed for you.'"

AMFEA also acts as what Gen. Pace describes as the "common's man" in

Europe for USAF units and the North Atlantic Treaty Organization and Mutual Aid countries on any logistic problems arising from deliveries from the U. S.

It supplies the data in covering AMFEA tries to determine who and eliminate the bottlenecks. It also helps the individual countries in establishing their own records in such as maintaining a continuous supply management system for the Greek or force in involving the pertinent supply requirements of the Turks.

In its role as "common's man," Col. Bostwick says, "AMFEA's position is being 'a kind of hold the common's hand'."

### Retiring F-100s

As a case in point, he cites a recent instance in which the retired F-100 wing in Turkey was experiencing a major supply problem that would result in Europe were not being. "The couldn't even get access to their logistic base," Bostwick says.

A complaint was circulated through AMFEA that specialists were sent to the F-100 base at Adana to work with the wing's material people and follow through on a job by one man. "They found," Col. Bostwick says, "that 85% of the trouble was within our AMAs." Most are now being taken in both Europe and the U. S. in to ensure that there will be no repeat.

Perhaps AMFEA claims include the management of disassembled equipment—Cessna, Cessna, Germany and Italy—as well as a number of sub-contract deals which supply food to all of the U. S. armed forces within their respective areas. One instance is that of U. S. "Disarm Center" in Europe in which it maintains emergency supplies of medicine, food and bedding to the U. S. forces in Germany for by sub-contract. Management of the US Navy Logistics office has been an AMFEA function since July 1960, shortly after that office was first to end war.

### Procurement Field

In the field of procurement and purchasing, however, items which AMFEA does at present are. In a recent letter to Gen. Pace upon AMFEA's selection as initiator of the Bag, Gen. Nelson S. Tibbitt. Armed for emergency procurement in the area Lt. Gen. William Maher, vice commander of the Logistics Command, said:

"Procurement of your organization can be complicated for handling in an emergency because complex problems are not necessarily encountered in procurement and maintenance and which required solution by individual initiative without benefit of precedent."

## PROBLEMATIC RECREATIONS 82



There are pairs of numbers whose sum and product are perfect squares. For instance  $5 + 20 = 25$  and  $5 \times 20 = 100$ . If the smaller number of such a pair is 1089, what is the other?

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An advanced drone helicopter powered by a turbine engine is being produced now by Gyrodyne for fleet deliveries.

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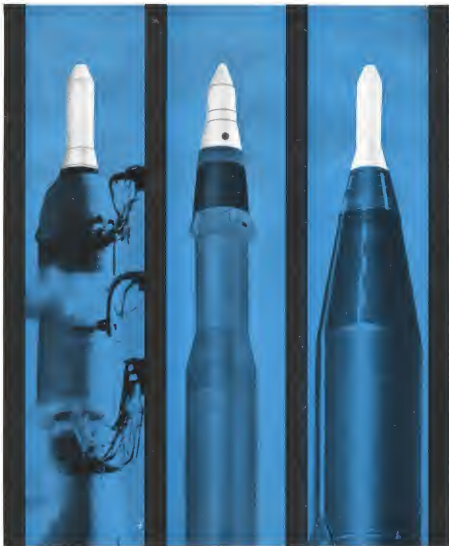
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